Engineering Library

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With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXXXIX.—No. 3622] LONDON: FRIDAY EVENING, MAY 29, 1925 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 16th June, 1925, for EXTENSIONS and ALTERATIONS for ACCELERATED LOW-PRESSURE HOT WATER HEATING at Halifax Post Office and Telephone Exchange.

Drawings, specification, conditions and form of contract, bills of quantities, forms for Tender, &c., may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners of H.M. Works, &c.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 9308

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—

1. SIX ELECTRIC SCOTCH DERRICK CRANES, 25 and 10 Tons, mounted on PONTOONS.
2. RAILWAY CARRIAGE UNDERFRAMES, BOGIE TRUCKS, &c.
3. WHEELS and AXLES.

Tenders due on the 12th June, 1925, for No. 1, and on the 23rd June, 1925, for Nos. 2 and 3.

Tender forms obtainable from above. 9323

Borough of Hertford.

ACTIVATED SLUDGE TREATMENT WORKS. CONTRACT NO. 3.

TO MANUFACTURERS OF RECIPROCATING AIR COMPRESSORS OR ELECTRICAL CONTRACTORS.

The Corporation of Hertford invite TENDERS for the complete EQUIPMENT of an AIR COMPRESSING and PUMPING STATION, to be erected at their Sewage Works, Mead-lane, Hertford.

The works included in the contract consist of L.T. Switchboards and Motors, Reciprocating Air Compressors, Centrifugal Pumps, Piping, Valves, Air Vessels, Cables, Measuring Apparatus, Cooling Tank, and other appliances, in accordance with the drawings, general conditions and specification prepared by the Engineer, Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

The drawings, general conditions, specification, and form of Tender may be obtained by bona fide manufacturers or contractors at the office of the Engineer on payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed "Sewage Disposal, Contract No. 3," must be delivered at my office at "The Castle," Hertford, on or before 10 a.m. on Monday, the 22nd June, 1925.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
(Sgd.) ALFRED BAKER,
Town Clerk.

The Castle, Hertford. 9311

City of Manchester.

The Electricity Committee of the Manchester Corporation invite TENDERS for the SUPPLY and DELIVERY of the following:—

SPECIFICATION No. 110.—CAST or WROUGHT STEEL PIPES and FLANGES, Stuart-street Station.

SPECIFICATION No. 111.—CENTRIFUGAL OIL PURIFIER, Barton Power Station.

Specifications, sketch and forms of Tender may be had on application to Mr. S. L. Pearce, Manager, Electricity Department, Town Hall, Manchester, on payment of a fee of One Guinea for each specification, which amount will be refunded on receipt of a bona fide Tender.

Tenders, duly endorsed and addressed to the Chairman of the Electricity Committee, must be delivered at the Town Hall not later than 10 a.m. on Tuesday, the 16th June, 1925.

The firms entrusted with the work will be required to enter into a contract to be prepared by the undersigned.

The Corporation do not bind themselves to accept the lowest or any Tender.

P. M. HEATH,
Town Clerk.

Town Hall, Manchester,
25th May, 1925. 9279

County Borough of Southampton.

RECONSTRUCTION OF COBDEN BRIDGE IN REINFORCED CONCRETE.

TENDERS are INVITED for the RECONSTRUCTION of the above-mentioned BRIDGE, having five spans of about 75ft. each, including the PROVISION of a TEMPORARY BRIDGE, APPROACHES and all incidental works.

Drawings of the proposed works can be seen at the office of the Engineer for the work, Mr. H. W. Fitz-Simons, B.Sc., Inst. C.E., 30, Victoria-street, Westminster. Copies of the specification, bill of quantities and form of Tender are to be obtained from the Engineer's office on payment of Five Pounds, which sum will be returned upon receipt of a bona fide Tender and the return of all documents.

Sealed Tenders, endorsed "Cobden Bridge, Concrete," must be sent to the Town Clerk, Southampton, not later than Ten o'clock in the forenoon on Monday, the 15th day of June, 1925.

The Corporation do not undertake to accept either the lowest or any Tender.

R. B. LINTHORNE,
Town Clerk.

18th May, 1925. 9234

County of London.

REPAIRS TO PAVEMENT OF CARRIAGEWAYS OF BLACKWALL AND ROTHERHITHE TUNNELS.

The London County Council invites TENDERS for REPAIRS to the GRANITE SETT PAVEMENTS and GRANITE CHANNELLING of BLACKWALL and ROTHERHITHE TUNNELS.

The specification, form of Tender, drawings, &c., may be obtained on application to the Chief Engineer of the Council, at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £3. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 8th June, 1925, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
Clerk of the London County Council.

9316

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Metallurgical Supplement.

The British Steam Railway Locomotive from 1825 to 1924—No. 22.

Guillemard Bridge over the Kelantan River.

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New Italian Warships.

Institution of Mechanical Engineers.

Steam Regeneration: Its Possibilities.

A Triple Electric Locomotive.

The German Institution of Engineers.

PUBLIC NOTICES

Metropolitan Borough of Wandsworth.

GAS ENGINE AND PUMP.

The Wandsworth Borough Council invite TENDERS for the SUPPLY, DELIVERY and ERECTION of a GAS ENGINE and PUMP at Streatham Cemetery, Garratt-lane, Tooting, S.W.

Drawings may be seen upon application to, and specification, bill of quantities, and form of Tender and contract obtained from, Mr. Ernest J. Elford, M. Inst. C.E., Borough Engineer, 215, Balham High-road, S.W. 17.

Tenders, on the form provided, enclosed in a sealed envelope, endorsed "Gas Engine and Pump, Streatham Cemetery," are to be delivered at the Council House, East-hill, Wandsworth, S.W. 18, and may be placed by the person tendering in the tender box provided for the purpose not later than Twelve Noon on Monday, June 15th, 1925.

The Council does not bind itself to accept the lowest or any Tender.

D. A. NICHOLL,
Town Clerk.

Council House,
Wandsworth, S.W. 18,
25th May, 1925. 9315

East Sussex County Council.

TRUNK ROAD RECONSTRUCTION SCHEME.

LONDON-BRIGHTON MAIN ROAD. CONTRACT No. 2.

TENDERS are INVITED for the WORKS of RECONSTRUCTION, WIDENING and RESURFACING the CARRIAGEWAY of the LONDON-BRIGHTON MAIN ROAD from the boundary of the County Borough of Brighton to a point about half-mile north of the Muddleswood Crossways.

Plans and conditions of contract can be seen at the office of the Resident Engineer, London-road, Pangdean, and form of Tender, bills of quantities and specification can be obtained from the undersigned on payment of a deposit of Ten Pounds, which will be returnable only upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "London-Brighton Road," are to be delivered at my office not later than the first post on Monday, the 15th June, 1925.

The County Council do not bind themselves to accept the lowest or any Tender.

F. J. WOOD, A.M.I.C.E.,
County Surveyor.

County Hall, Lewes,
20th May, 1925. 9265

WEST WHARF, CARNWATH-ROAD, FULHAM, S.W. 6.

DRY DOCKING, &c., OF PONTOON AND DREDGING WORK.

The Metropolitan Asylums Board invite TENDERS for the following WORKS:—

(1) DRY DOCKING, REPAIRING and PAINTING FLOATING PONTOON and REPAIRING DOLPHINS and SUPPORTING of PIER BROW; and

(2) DREDGING WORKS in the vicinity of the Pontoon.

Specification, conditions of contract, and form of Tender for each work may be obtained at the office of the Board, Victoria Embankment, London, E.C. 4. Intending contractors should state, when applying for Tender forms, which work it is proposed to Tender for.

Tenders for each work, addressed as noted on the forms of Tender, must be delivered at the office of the Board not later than 10 a.m. on Wednesday, 17th June, 1925.

G. A. POWELL,
Clerk to the Board.

9280

PUBLIC NOTICES

TENDER.

County Borough of Stoke-on-Trent.

(GAS DEPARTMENT.)

GAS CONSOLIDATION ACT, 1922.

CONTRACT NO. 31.

The Gas Committee invite TENDERS for the CONSTRUCTION of ADDITIONAL RAILWAY SIDINGS at Etruria Gasworks.

Persons desirous of tendering are requested to make written application to the Chief Gas Engineer, Gas works, Etruria, Stoke-on-Trent, not later than Monday, the 22nd June, 1925, and to enclose deposit of £1 Treasury note, which will be returned on receipt of a bona fide Tender and the return of all plans and documents, and also provided Tenders are received by the date mentioned.

Sealed Tenders to be forwarded to the undersigned not later than Twelve Noon on Friday, the 3rd July, 1925, and endorsed "Tender for ——."

E. B. SHARPLEY,
Town Clerk.

Town Hall, Stoke-on-Trent,
May 26th, 1925. 9301

The South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

1. CYLINDRICAL BUFFERS.
2. SPRING STEEL.
3. MILD STEEL PLATES for Miscellaneous Purposes.
4. COPPER TUBES and LEAD SHEETS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Cylindrical Buffers," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 5th June, 1925.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specification No. 1, 2s. 6d. for each copy of Specification No. 2, and 5s. for each copy of Specifications Nos. 3 and 4.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1.
21st May, 1925. 9276

Tilbury Urban District Council.

BURIAL GROUND AT CHADWELL ST. MARY.

The above Council invite TENDERS for the SUPPLY and ERECTION of about 330 LINEAL YARDS of "GREENHILL" or other approved SELF-ADJUSTING RAILING in 9ft. panels, together with GATES and CAST IRON PILLARS.

The form of contract may be seen and copies of specification, plan, Tender forms, and further particulars obtained on application to Mr. S. A. Hill-Wilde, M. Inst. C.E., A.M.I. Mech. E., Engineer and Surveyor to the Council, on and after Wednesday, May 27th, upon receipt by the Council's Accountant of a deposit of £1 (One Pound), returnable on receipt of a bona fide Tender.

Sealed Tenders, on the forms and in the envelopes provided, are to be received by me not later than Noon on 6th June, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

A. W. BUCKNER,
Clerk of the Council.

Council Offices, Tilbury,
21st May, 1925. 9298

PUBLIC NOTICES

Egyptian State Railways, Telegraphs and Telephones.

APPLICATIONS for the following APPOINTMENTS are REQUIRED and should be addressed to THE GENERAL MANAGER, c/o The Inspecting Engineer (Egyptian Govt.), Queen Anne's Chambers, Westminster, S.W., not later than June 10th, 1925.

1. ASSISTANT to CHIEF MECHANICAL ENGINEER, at £E1000 per annum, to be in charge of the Drawing-office.
2. DESIGNER, at £E600 per annum, to assist the candidate referred to above in (1).
3. TWO BOILER INSPECTORS, at a salary of £E480 each.

No other remuneration will be paid in addition to the salaries mentioned above.

Appointment will be made on contract for period of two years.

Copy of contract and list of qualifications required from applicant can be obtained from the Inspecting Engineer's Office. 9238

Egyptian State Railways Telegraphs and Telephones.

APPLICATIONS for the following APPOINTMENTS are REQUIRED and should be addressed to THE GENERAL MANAGER, c/o The Inspecting Engineer, Egyptian Government, Queen Anne's Chambers, Westminster, S.W. 1, not later than June 10th, 1925.

1. ELECTRICAL SIGNAL ENGINEER, at £E600 per annum.
2. ELECTRICAL ENGINEER, at £E360 per annum.
3. ONE DESIGNER, at £E600 per annum, to assist in the Technical Office of Mechanical Dept.
4. ONE MACHINE SHOP FOREMAN, at £E600 per annum.
5. ONE JUNIOR DESIGNER, at £E360 per annum, to work in the same office as No. 3.

No other remuneration will be paid in addition to the salaries mentioned above.

Appointment will be made on contract for period of two years.

Copy of contract and list of qualifications required from applicant can be obtained from the Inspecting Engineer's Office. 9302

South Indian Railway Company, LIMITED.

The Directors are prepared to receive written APPLICATIONS from duly qualified candidates for the APPOINTMENT of an ASSISTANT BRIDGE ENGINEER on the Company's staff in India.

Candidates should be between the ages of 25 and 30 years. They must have received a sound general and technical education, and should have had two years' practical experience of Constructional Work under a qualified Civil Engineer or as an Assistant Engineer on the staff of a British Railway Company.

Candidates must also have served in the Bridge or Constructional Steelwork Department of a British Railway or in the Works of a British Bridge-building Firm. Alternatively, they must have been Articled to or worked as an Assistant with one of the leading firms of Bridge Builders, and have had some Erecting Experience.

They must be Associate Members of the Institution of Civil Engineers or have passed one of the qualifying examinations for such membership.

The appointment will be for three years, and may be extended.

The starting salary of the successful candidate will be fixed according to qualifications, with a minimum of Rupees 450 per month, inclusive of overseas allowance, and rise by annual increments of Rupees 50 per month to a maximum of Rupees 800 per month.

The incumbent will be entitled to the benefits of the Company's Provident Fund.

The Company will provide a first-class passage to India, and the salary will commence from the date of sailing.

Forms upon which applications must be made may be obtained from the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1.
26th May, 1925. 9317

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PUBLIC NOTICES

Sudan Government Railways

REQUIRE the SERVICES of a DISTRICT LOCOMOTIVE SUPERINTENDENT. Age 26 to 32, preferably single. Candidates should have been trained on a British railway or in a locomotive builder's works, and should have good knowledge of the working of a locomotive department. Commencing salary £E480 to £E540, according to age and qualifications. Permanent and progressive post if satisfactory. A.M.I.M.E. degree or equivalent desirable. Strict medical examination. Free first-class passage. Liberal leave and assisted passages.—Apply by letter to ADVISORY ENGINEER, Sudan Government, London Office, Wellington House, Buckingham-gate, S.W. 1. 9296

The Municipality of Singapore,

STRAITS SETTLEMENTS.
SEWERAGE DEPARTMENT—ASSISTANT ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER for the Sewerage Department, age 28-35, well educated, of sound constitution and preferably unmarried. Candidates must be qualified to design and construct sewers and sewerage details, including pumping mains, and must have special knowledge of the latest methods of the purification of sewage to the standard of the British Commission Report. The selected candidate should have had special experience on one or other of the various activated sludge systems at work in this country.

The appointment will be for three years, with possible extension. The selected candidate must pass a medical examination as to his fitness for service in Singapore. A passage will be provided with half salary during the voyage out.

The salary will be $160 dollars per annum, paid monthly, the value of the dollar being two shillings and fourpence sterling. At this rate the salary would amount to £952. An allowance for such transport as might be required on duty would be granted.

Applications, stating age and place of birth, and giving details of education, training and experience generally, stating when free, accompanied by copies (only) of testimonials, and also personal references, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, agents to the Commissioners (from whom further information may be obtained), not later than Tuesday, 2nd June, 1925. 9241

SITUATIONS OPEN

WANTED by Firm in the Midlands, Practical CHEMIST for Grey Iron Foundry. One having sufficient experience in Mixing Metals to Take Charge of the Metal Side from the Pig to the resultant Irons.—Address, with full particulars and salary required, 9299, The Engineer Office. 9299 A

WANTED by Large Swiss Engineering Firm, Young MECHANICAL ENGINEER for Marine Auxiliaries and Turbo-compressor Estimating and Sales Department. Applicants must have had test bed and office experience with this class of work and preferably some marine experience with turbo machinery. A working knowledge of French or German is desirable.Address, giving full particulars of qualifications, age, salary expected, and copies of three testimonials, 9278, The Engineer Office. 9278 A

APPLICATIONS are INVITED for the Following POSTS at the Royal Aircraft Establishment:—
REF. A.67.—JUNIOR TECHNICAL ASSISTANT, with technical training to standard of B.Sc. Engineering Degree and good knowledge of technical French, for work in connection with airworthiness of aircraft. Experience in administrative work essential; flying experience or general knowledge of aircraft an advantage. Commencing salary £175 a year plus Civil Service bonus (giving at present rate a total of £278 19s.) on the scale £175-£15-£235 plus bonus. Ex-Service man preferred.
REF. A.68.—TEST ASSISTANT, with technical training to standard of B.Sc. Engineering Degree, required for work in connection with airworthiness of aircraft. Starting salary 60s. a week plus Civil Service bonus, giving present total of £4 17s. 3d. Ex-Service man preferred.
Write, quoting appropriate reference number, to the SUPERINTENDENT, R.A.E., South Farnborough, Hants. 9319 A

EXPERIENCED ENGINEER REQUIRED, Fully conversant with the latest designs of Condensing Plant and the preparation of estimates and negotiation of orders for same.—State age, experience, salary, and qualifications, and send testimonials to W. H. ALLEN SONS and CO., Ltd., Bedford. 9281 A

PROGRESS MAN WANTED for Switchgear Factory. Real live man with practical experience, capable of following all details through manufacture, despatching orders strictly to date, and dealing with all correspondence.—Write, giving full particulars, age and salary required, to Box 981, Sells, Fleet-street, E.C. 4. 9313 A

REQUIRED by Firm Manufacturing Radio Components in large quantities, MAN fully qualified to control detail part stores and keep full records; also MAN for warehouse despatch.—Write, in own handwriting, full particulars, age and wages, to Box 982, Sells, Fleet-street, E.C. 4. 9314 A

TEST ASSISTANTS REQUIRED in the Metallurgical Department of the Royal Aircraft Establishment for work in connection with investigations in ferrous and non-ferrous materials. Applicants should possess degree in Metallurgy or training and attainments of equal standing. Ex-Service man preferred. Starting salary 50s. a week plus C.S.B., giving a present total of £4 3s. 7d. a week
Apply, quoting A.61, to the SUPERINTENDENT, R.A.E., South Farnborough, Hants. 9318 A

WANTED, DRAUGHTSMAN, Accustomed to General Engineering and Chemical Plant Work. State age, experience, &c.—Address, 9287, The Engineer Office. 9287 A

WANTED, DRAUGHTSMAN, by Well-known Firm of Milling Engineers.—Address, stating experience, &c., 9285, The Engineer Office. 9285 A

WANTED, ESTIMATING DRAUGHTSMAN, Capable of quick and accurate work from drawings of General and Chemical Plant. State age, experience, &c.—Address, 9288, The Engineer Office. 9288 A

DESIGNING DRAUGHTSMAN REQUIRED for Mechanical Handling Plants for Coal and other materials; first-class experience essential.—Address, stating age, full details of experience and salary required, P672, The Engineer Office. P672 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 8768 A

DRAUGHTSMAN, First Class, for Design and Detail Work of all Commercial Vehicle Components.—State age, experience in full and salary required to DENNIS BROS., Ltd., Guildford. 9236 A

DRAUGHTSMAN, Grade III., REQUIRED for work in connection with Instruments and Small Mechanical Apparatus. Applicants should have had good technical training and some experience in work of a similar nature. Salary from 40s. to 52s. per week plus Civil Service bonus (giving present total remuneration of from 69s. 11d. to 86s. 4d. per week), according to experience. Ex-Service man preferred.—Write, giving full particulars of experience and qualifications and quoting A.63, to SUPERINTENDENT, R.A.E., S. Farnborough, Hants. 9307 A

DRAUGHTSMAN, Midlands, Experienced in arrangement and details of Pipe Work for complete Power Installations, taking own measurements on site. State age, experience, and salary.—Address, 9277, The Engineer Office. 9277 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN (Unmarried), Experienced in Structural and Reinforced Concrete Work, REQUIRED for large Company for Chile. Three years' agreement; first-class passage out and home.—Write full particulars in duplicate, and state salary expected, to "S.88," c.o. Deacon's, 11, Fenchurch-avenue, E.C. 3. 9324 A

MECHANICAL DRAUGHTSMAN REQUIRED, Works in South of England. State qualifications and salary.—Address, 9325, The Engineer Office. 9325 A

SENIOR DRAUGHTSMAN DESIGNER WANTED IMMEDIATELY; also JUNIOR. Preference given to applicants with experience of Aero-engine or High-class Automobile Work. Knowledge of High-speed Oil Engines an advantage. Full particulars of experience, age, and salary desired.—Address, "DRAUGHTSMAN," Wm. Porteous and Co., Advertising Agents, Glasgow. P651 A

SHIP DRAUGHTSMAN WANTED for Works in the Far East. Single man preferred, age not exceeding 33. Must have general knowledge of smaller class of work, Tugs, River Steamers and Coasters.—Address, stating experience, 9309, The Engineer Office. 9309 A

FOREMAN WANTED to Take Charge of Modern Shop for the Production of Cast Iron, Cast Steel Valves and Boiler Mountings; must have good experience of this class of work.—Address, 9321, The Engineer Office. 9321 A

ENGINEERS' PATTERNMAKERS; Permanency for suitable men. District rate.—Apply, F. J. SMITH, 2 and 2a, Wynyatt-street, Goswell-road, E.C. 1. P659 A

SITUATIONS WANTED

MR. E. W. WHATTAM, of "Longsight," Yarboro-road, Lincoln, has resigned his appointment as travelling director of Messrs. Wm. Foster and Co., Limited, Engineers, Lincoln, after a service of 26 years. He still retains a seat on the board, but will be OPEN for a TRAVELLING APPOINTMENT at an early date. He has extensive connections in England, Scotland, and abroad, and wishes to thank all his old friends for their kind support. P664 B

A.M.I.C.E. (34), Thorough Works and D.O. Training, locomotive, mechanical, steam, wide experience maintenance work and organisation and control of large staffs, keen economist, some commercial experience, Freemason, URGENTLY DESIRES PROGRESSIVE POST.—Address, P641, The Engineer Office. P641 B

AS WORKS MANAGER.—A MAN, with Wide experience in above capacity, DESIRES CHANGE where energy and zeal are appreciated. Fullest particulars will be furnished to inquiring companies.—Address, P649, The Engineer Office. P649 B

C.E. WANTS ENGAGEMENT. Many Years' experience railways, bridges, warehouses, setting out and supervision, good surveyor, leveller and draughtsman. Knowledge German and Spanish.—B., 202, Victoria-avenue, Southend. P658 B

CHARTERED CIVIL ENGINEER SEEKS APPOINTMENT; experience engineers' and contractors' side, and the carrying out of work by direct labour; reinforced concrete, pile driving, roads, bridges, railways, tunnels, caisson sinking, contract plans, parliamentary surveys.—Address, P623, The Engineer Office. P623 B

ENGINEER AND WORKS MANAGER AT LIBERTY. Good all-round engineering experience, organising and administrative ability; held responsible positions as works and chief engineer and works manager; energetic and disciplinarian; highest refs.; age 37.—M. EVERTON, Coleridge-road, Ashford, Middlesex. P608 B

ENGINEER (MARINE), at Present Assistant to superintendent engineer of well-known line of steamers, DESIRES SIMILAR APPOINTMENT at home or abroad.—Address, P667, The Engineer Office. P667 B

EXPERIENCED ENGINEER WORKS MANAGER, at present in charge of office and works, DESIRES CHANGE. Specialist in all branches of pressed metal, auto, and capstan lathe productions, deep-drawn hollow-ware in steel and all non-ferrous metals, design tools, good organiser, and disciplinarian. Would represent firm on the road. Age 35.—Address, P657, The Engineer Office. P657 B

MANAGER, Works and General (39), At Liberty, with successful record, REQUIRES POSITION; constructional and general engr., including drop stamp, and mass prod. exp.; ex. refs.; home or abroad; moderate salary.—Address, P642, The Engineer Office. P642 B

MEASURING PUMPS.—ENGINEER, Experienced installation, design, patents, organisation, services can be SHORTLY AVAILABLE. £800.—Address, P648, The Engineer Office. P648 B

WATERWORKS ASSISTANT (30) REQUIRES similar POST, or as ASSISTANT MANAGER of Water Company. Ten years' experience all branches of water supply. Excellent technical and personal qualifications. Energetic and able to take charge of outdoor staff.—Address, P655, The Engineer Office. P655 B

WOODWORKING MACHINERY.—Expert DESIGNER and ADVISER (36) DESIRES responsible POSITION abroad. Accustomed to designing all types of machines, preparing plans and estimates for complete saw milling plants and wood refuse removal installations, testing and demonstrating. Salesmanship experience and conversant with modern machine shop practices.—Address, P661, The Engineer Office. P661 B

WORKS MANAGER, with 19 Years' Shop Management experience in highest class engineering products, SEEKS POST, either in Works or as Representative; aged 40, married; public school education.—Address, P673, The Engineer Office. P673 B

YOUNG ELECTRICAL ENGINEER, Englishman, first-class technical and works training in England, DESIRES POSITION with large supply company in England or with firm of consulting engineers undertaking power development overseas. At present with large Canadian hydro-electric and steam utility and dealing with steam and hydraulic power generation and long-distance extra high-tension transmission. Highest references in England and Canada. Present salary £320.—Address further particulars, P662, The Engineer Office. P662 B

YOUNG ENGINEER (23) DESIRES POST (Abroad preferred); experienced in Diesel oil engines, practical and theory; also shop management; excellent references.—Address, JACKSON, Fern Lea, Bramhall, near Stockport. P670 B

YOUNG ENGINEER, 4½ Years' Experience Mech. engineering in shops and D.O., also knowledge of petrol engines, SEEKS POSITION in D.O. or shops; keen, hard-working and willing.—Address, P674, The Engineer Office. P674 B

DRAUGHTSMAN (30), Quick, Reliable; Structural, mechanical, general, factory lay-out, mechanisms, SEEKS SITUATION.—Address, P663, The Engineer Office. P663 B

FOREMAN M/C SHOP, 22 Years' Exp. General and motor, caps., autos, lathes, and boring m/c., DESIRES progressive CHANGE, toolroom or production.—Address, P654, The Engineer Office. P654 B

SITUATIONS WANTED (continued)

FOUNDRY FOREMAN.—A SITUATION WANTED by a first-class MOULDER and FOUNDRY ORGANISER, used to control of men, mixing and melting of metals, iron and non-ferrous. Excellent references.—Address, P650, The Engineer Office. P650 B

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
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Inquiries to be addressed to C. F. G. KJELLBERG, Engineer, c/o Nydqvist and Holm Aktiebolag, Trollhattan, Sweden. 9295 H

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For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

The Birmingham Canal Scheme.

THE scheme for providing a canal, capable of accommodating 100-ton barges, from Birmingham to the sea was advanced a step further on Wednesday, when a deputation waited on the Minister of Transport to enlist his sympathy and elicit information as to the extent of the financial assistance which might be expected from the Government. The deputation was introduced by Colonel Ward, and the Birmingham representatives included the Lord Mayor, Alderman Percival Bower, Councillor P. Carter and Major Aveling. Representatives also attended from Liverpool, Manchester, Wolverhampton, Stoke-on-Trent, Smethwick, Walsall and West Bromwich, besides the Mersey Docks and Harbour Board. The scheme, it is estimated, will involve an expenditure of £6,593,627, and it is expected that the annual cost will be £433,816. The waterway would follow, to some extent, the routes of existing canals, and would be 82 miles in length, passing through Wolverhampton and going thence through the Potteries, to the Weaver Navigation. Besides accommodating much larger barges than the present canals can accommodate, the scheme would effect a considerable saving in time, as it is anticipated that the whole journey could be accomplished in about 34½ hours, as against 50 hours by the present route.

The Printing Exhibition.

THE International Printing, Stationery and Allied Trades' Exhibition, which was opened at the Agricultural Hall, London, by Prince Henry on the 16th inst. and closes to-morrow—Saturday—is the seventh of its kind, and has undoubtedly been a great success. It is noteworthy that the whole of the space available is taken up by exhibits, but ample gangways have been arranged, so that visitors can comfortably inspect the machinery, and it is noticeable that the majority of the visitors take a technical interest in the show and are not merely sight-seers. Almost all the plant is shown in motion, and it includes all kinds of machinery used in the printing trade, with the exception, of course, of the big rotary presses used by the daily papers, which would be far too massive for erection in the hall. There is also a variety of machines used in the stationery trade, such as envelope-folding, carboard-box making, stitching and gumming machines, besides some fine exhibits of engraving work, type metals, and so forth. Being an international exhibition, it is natural that there should be machines from Canada, America and the Continent on view, but most of the exhibits are British.

The Iron and Steel Trade.

SPEAKING at a luncheon last week of the National Federation of Iron and Steel Manufacturers, the chairman, Mr. A. O. Peech, remarked that the average selling price of British iron and steel products was little more than 30 per cent. above the pre-war level, whereas general commodities were 66 per cent. above the 1913 figure. Even so, the demand was insufficient to provide a means of livelihood to all those who normally would be engaged in the industry. That position, he said, was produced by the competition of continental countries. He estimated that the idle workers in the industry cost the country £7,000,000 a year, a figure equivalent to a subsidy of about £2 18s. on every ton of imported steel. Sir Philip Cunliffe-Lister, following Mr. Peech's remarks, admitted that in the first four months of this year the imports of iron and steel had been higher than in any previous period in the history of the industry, but while referring to the Safeguarding of Industries Act was cautious not to commit the Government to any definite course of action aiming at the assistance of the iron and steel trades. Mr. C. E. Lloyd, the President of the Federation, was more definite. If, he said, a prolonged period of very low output and extreme unemployment was to be avoided, the industry might be forced to seek temporary and special help from the Government. He believed that the employers and employed in the industry would, with sympathy and support from other interests in the country, succeed in evolving some proposition that, if approved and put into force, would ameliorate the situation.

Range of Battleship Guns.

SOME interesting disclosures as to the range of modern naval guns are contained in the report of the recent hearing before a Naval Sub-committee of the United States Senate, which held an inquiry into the state of the American battle-fleet. It is common knowledge that an agitation has been proceeding in the United States for the modification of turret gun mountings in thirteen battleships, with a view to increasing their maximum range, it having been alleged that the British Fleet enjoyed a marked advantage in this respect. According to official evidence taken by the Sub-committee, the actual position is, however, quite otherwise. It appears from this evidence that two American battleships, armed with 14in. guns, have an extreme range of 35,500 yards, and that three other vessels, mounting 16in. guns, are able to range up to 34,500 yards. In the British Fleet the Hood has 15in. guns, capable of firing at 30,300 yards, but with this solitary exception, all the other British ships are limited to a range of 24,300 yards or less. While, therefore, a disparity between the maximum shooting ranges of the two fleets does exist, it is clear that the disadvantage is wholly on the side of the British Fleet. If the mountings of thirteen older American ships were altered to give an elevation of 30 deg., as the Navy Department has proposed, this difference would be very greatly accentuated, and the British Government could hardly avoid taking remedial measures. As it is, however, President Coolidge has definitely vetoed the proposed alterations, and the subject is therefore shelved for the time being.

Synthetic Ammonia.

SPEAKING last week at the annual general meeting of Brunner, Mond and Co., Ltd., the chairman of directors, Mr. Roscoe Brunner, gave some particulars regarding the developments which the company is now carrying out at its Bellingham synthetic ammonia works. The company makes use of the Haber process, a process which, after examination, its experts hold to be at least as efficient as the Claude, Hauser or Casales. It began operations with a one-ton experimental plant at the Weston Point works of the Castner-Kellner Company. Then, after purchasing the Billingham works from the Government, it set up a research laboratory at a cost of £80,000 to investigate and develop the Haber process. Subsequently a plant with a nominal capacity of 30 tons of pure ammonia per day was erected at Billingham. Much of the equipment was of a type new to British engineers, the plant took a long time to build, and considerable difficulties were encountered in its operation. For a long time its output was less than the nominal 30 tons a day, and it was run without profit. In spite of this experience the directors courageously decided to increase the plant to a capacity of 50 tons per day. The new equipment is not yet at work, but the 30 ton plant is now running profitably at full output. The ammonia is converted into sulphate of ammonia, of which 3.8 tons are obtained from a ton. The sulphate commands a high price because of its great purity. With the aid of a Government guarantee on a sum of two million sterling, the capacity is to be increased from 50 tons to 150 tons of ammonia per day. Brunner Mond and Co. are, in addition, to add the money necessary to raise the capacity to 200 tons, equivalent to a sulphate output of 760 tons per day. The ammonia will be converted into other salts besides the sulphate. The whole of the two million pounds referred to is, it is good to learn, to be expended in this country.

New Furness, Withy Motor Ships.

IT is announced that Furness, Withy and Co., Ltd., have invited offers from British shipbuilders for the construction of four additional motor ships. These vessels were mentioned by Sir Frederick Lewis on the occasion of the annual meeting of the Gulf Line, Ltd., on March 17th last, when it was indicated that new ships would be required for that company's trade, and that the specifications were then in course of preparation. The new vessels are to be somewhat slower in speed, we understand, than the five fifteen-knot ships which were recently ordered from the Deutsche Werft at Hamburg. It is to be hoped that these four additional ships will be secured by home yards. Several meetings of both the employers and men have already taken place, and although the deliberations have not been made public, it is safe to assume that the main reasons for the low prices quoted by German builders are understood and their importance appreciated. Some hope is given that the orders will not go abroad this time by Sir Frederick Lewis's statement quoted in our journal note of March 20th, that the determining difference in price between British and German-built motor vessels only begins when speeds above 10 to 11 knots are contemplated.

Gaseous Explosions.

THE Explosions in Mines Research Committee was appointed in September, 1922, by the Secretary for Mines to carry out research into the causes of, and the means of preventing, the ignition of firedamp and coal dust by the firing of "permitted" explosives. It is a subsidiary body to the Safety in Mines Research Board. From its second report, published at the end of last week, we gather that the Committee is doing a considerable amount of work which should indirectly possess much interest to internal combustion engineers. For instance, by means of a photographic method, it has been studying the form and appearance of the pressure wave resulting from a detonation. The very rapid and extensive rise of pressure behind the wave front produced by detonation within an explosive mixture may of itself, it is found, be sufficient to cause ignition of the mixture without the intervention of a flame. Thus a mixture containing 6.5 per cent. methane and initially at normal temperature and pressure, can be ignited if subjected rapidly by mechanical means to a compression of about 54 atmospheres. Of mixtures containing from 5 to 12 per cent. of methane, the most readily ignitable by suddenly applied pressure was found to be one containing about 7 per cent. of methane. Somewhat curiously the mixture most readily ignited by a momentary flame is not the same but one containing 10 per cent. of methane. The Committee is studying the lag of ignition in a methane mixture in contact with a heated surface, and has developed means whereby lags as short as one hundredth of a second can be measured.

Controlled Elastic Limit Steel for Ships.

THE Prometheus, Alfred Holt and Co.'s new twin-screw motor ship, which was launched from the Cartsdyke Yard of Scott's Shipbuilding and Engineering Company, Ltd., last week, promises to be a vessel of unusual interest. Indeed, it is said that she will open a new era in shipbuilding. She is built of a new steel which has been developed by Mr. F. Grimshaw Martin, metallurgical and research chemist to Messrs. Holts, in conjunction with David Colville and Co., Ltd., of Motherwell. This new steel was described in a paper read before the 1924 spring meeting of the Institute of Naval Architects, and a somewhat heated and controversial discussion followed. Alfred Holt and Co. have, however, an implicit belief in the far-reaching possibilities given by the new steel, and to this end they decided to give it a test in the ship 425ft. in length, which has just been launched. The scantlings decided upon were accepted by the Board of Trade and the classification societies, and there has been a saving in weight, it is claimed, of fully 10 per cent. as compared with a ship built of ordinary plates. In referring to this steel in our issue of January 2nd this year, we pointed out that the material is an ordinary carbon steel of 28 to 30 tons tensile strength, which is manufactured under conditions which ensure that its true elastic limit, or limit of proportionality, is not less than 16 tons, compared with 8 tons, a usual value for ordinary ship steels. The propelling machinery of the Prometheus will consist of two sets of four-stroke single-acting oil engines of the Burmeister and Wain type, designed to develop a total of 3700 shaft horse-power. All the auxiliaries will be electrically driven.

Irrigation in Peru.

SOME particulars have just been published of an important irrigation scheme for Peru, which should add materially to the supplies of cotton available for manufacture in Lancashire. The river Cañete has already been utilised for the irrigation of 20,000 acres of the Pampas, and now work has been started on another project which will irrigate 120,000 acres, while another will cover 300,000 acres. The smaller of these two schemes will cost about £P5,000,000 and will take five years to complete. A dam is to be constructed at Carhuaquero, 75 kiloms. from the port of Pimentel, and will impound 40 million cubic metres of water, which will be utilised in the districts of Chiclayo and Lambayeque. The scheme will involve the construction of a tunnel 9 miles long under the Andes for diverting the Huancabamba River to the western slope of the mountains. The second scheme is concerned with a large area of virgin pampa in Southern Peru and the concessionnaires are empowered to tap the rivers Camaná, Majes, Calca and Sihuas.

Gas versus Electricity.

WHILE the Government is repeatedly expressing its interest in and desire to develop the electric supply industry of the country, those connected with the manufacture and sale of gas are not content to lie idle. It would seem that the gas industry feels that its position is being challenged, if not threatened, by the developments and the proposed developments of the electrical industry. Mr. D. Milne Watson, during the past few days, has expressed himself vigorously on the situation. At the annual meeting of the Society of British Gas Industries on the 20th and again at the annual meeting of the National Gas Council on the 26th—of both of which bodies he is, or was, president—Mr. Milne Watson protested against the proposed State aid to the electrical industry. He argued that the gas industry made proportionately a much smaller demand upon our dwindling coal resources than the electrical industry. It was fallacious, he held, to argue that the high cost of electrical energy in this country was a factor in causing unemployment. Nowhere was the industrial depression greater at present than on the North-East Coast. Yet there was situated the largest super-electricity station in the country, supplying very cheap energy over a large industrial area. The capacity of the new Barking station opened by the King last week was, he declared, no more than equal to that of the extension required annually by the largest London gas company to meet its normal increase in business. To equal the heat energy delivered by the neighbouring Beckton gasworks the Barking station would require to have ten times its present maximum capacity. There was ample room, he held, for both industries, but a fair field and no favour should be provided. The Government's proposals in connection with the subsidising of the already prosperous electrical industry were causing surprise, indignation and anxiety in the gas world.

The British Steam Railway Locomotive from 1825 to 1924.

By E. L. AHRONS, M.I. Mech. E.

No. XXII.*

PERIOD 1860 TO 1865 (*continued*).

Frames.—It is unnecessary to add much to the particulars already given, beyond pointing out that solid plate frames were still welded, and the time for slotting them out of a solid rolled plate had not yet arrived.

The method of securing outside cylinders to the main frames by deepening the latter and slotting an aperture through which the steam chests passed was used by Sinclair from the end of 1859, though it had been introduced by Allan on the Scottish Central Railway in 1856. The steam chests were fitted to the frames by ribs, and a connection was made across the engine by a box either of plates and angles or in later engines by flanged castings.

Radial and Other Axle-boxes with Lateral Movement.—Whether, following Roy's 1857 design, W. Bridges

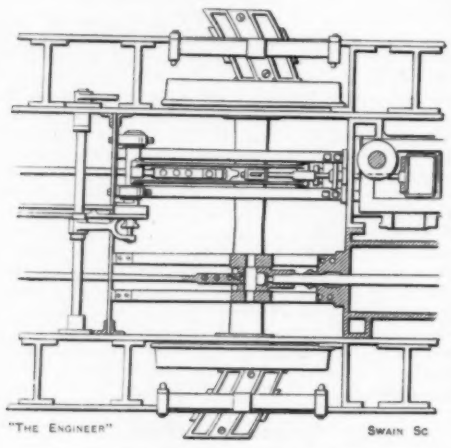


FIG. 171—W. BRIDGE ADAMS' RADIAL AXLE

Adams was the next to invent a radial axle, in 1863, is uncertain, since a prior claim has been made on behalf of Wöhler,[1] locomotive superintendent of the Lower Silesian Railway, whose name is so well known in connection with the classic experiments on repetition of stress. But the date of Wöhler's radial axle-box is doubtful, and the writer cannot trace an engine so fitted before 1865. Wöhler, however, arranged for a controlling force by means of a special spring pillar with a loose cam-shaped piece between it and the axle-box, such that the pressure of the spring caused the box to return to its mid position. Adams's early radial axle-boxes had no controlling force, with the result that on straight track there was considerable lateral oscillation of the radial axle. The idea of a controlling force was suggested in 1864[2] by G. H. Phipps, who proposed a plate spring perpendicular to the axle and pressing

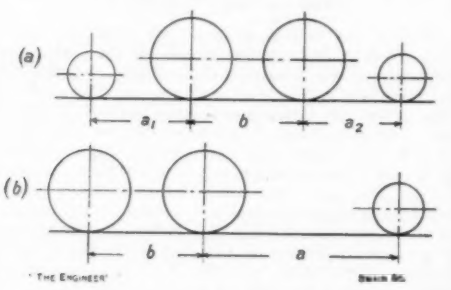


FIG. 172

against the collar of the journal. Phipps's suggestion was afterwards carried out in a modified form by Webb and others.

The original form of Adams's axle-box which had a central collar on the journal is shown in Fig. 171.

The length allowed for the radius of curvature of these early axle-boxes and Bissell trucks is of interest, and the three types of engine already described may be compared. In the "White Raven," the first engine built, which was of the 2–4–2 type, a_1 and a_2—Fig. 172—were equal, and the rigid wheel base was equal to b. The radius of curvature at each end was equal to a_1 or a_2. There was no apparent reason for this dimension, which seems to have been tentative. Subsequently W. B. Adams made some experiments on the North London Railway, the details of which have not been left on record; but he arrived at the conclusion that the centre of the radius should be midway between the radial axle and a point halfway between the centres of the rigid axles, that is $r = \frac{a + \frac{b}{2}}{2}$. The radius for the 0–4–2 tank engines of the L.C. and D.R. was calculated in this way. That of the G.N.R. engines, in which a was 1ft. longer, should by this rule have been 8ft. 3in., but was made 8ft. 6in. In the case of the Great Eastern 2–4–2 tank engines the same rule was used, and it seems to have been the original intention to employ it in the G.E.R. engines to have had Bissell trucks at both ends, but as built the trailing axle was fixed, so that the rigid wheel base was $b + a_2$. In spite of this change no alteration was made in the length of the radial arm at the leading end.

Baldry's later rule, derived mathematically from Euclid III. 36, may be most simply expressed $r = \frac{a\,(a + b)}{2\,a + b}$, a value which is less than that given by Adams's rule by an amount equal to $\frac{b^2}{4\,(2\,a + b)}$. Baldry's rule makes no allowance for flange clearances, and the length of radial arm derived from it should be lengthened to maintain the flange of the radial wheel against the outer rail and so prevent "hunting" of the axle from side to side. Taking these points into consideration, it will be found that Adams's old empirical rule gives results not far from those used in the best practice of to-day, except in the case of 2–4–2 tank engines.

The parallel end axles of the eight wheels coupled tank engines of the Vale of Neath Railway were provided with the somewhat complicated controlling arrangement shown in Fig. 173, the invention of M. Caillet, and patented in this country by Mr. Slaughter, of the Avonside Engine Company. Two laminated controlling springs were mounted on a transverse rod, the ends of which were extended to enter freely into recesses in the bearing spring pillars. On to these extensions forked brackets were screwed, the outer ends of which abutted against the sides of the bearing spring pillars, the inner ends bearing on the extremities of the laminated controlling springs. Nuts at each side could be screwed up to give an initial controlling force. In mid-position the outer ends of the forked brackets did not exert any pressure against the vertical spring pillars. The latter had rounded ends which fitted into recesses in loose pieces sliding on the tops of the axle-boxes. The lateral movement of the axle-boxes was allowed for by making their width between flanges greater than the faces of the horncheeks. When the axle was displaced laterally on a curve the axle-boxes moved underneath the surfaces of the pieces below the spring pillars, moving the forked bracket, and compressing the controlling springs. No movement took place until the initial controlling force was overcome. The initial resistance offered by the check springs was 24 cwt. The arrangement proved defective in that the force due to the check springs was transmitted to the engine frames in such a way that the latter, not being sufficiently stiff, bent outwards, and the transmission through the vertical spring pillars was also mechanically defective. The arrangement is interesting in that it was the earliest case in which check springs appear to have been actually used.

Bogies.—In 1865 we meet with the first tender engines with four-wheeled bogies, with lateral movement of the pivot in six 4–4–0 engines with outside cylinders built by Neilson to the designs of W. Cowan for the Great North of Scotland Railway. These engines are illustrated in Colburn's "Locomotive Engineering." The bogie had a long 6ft. wheel base. The spherical pivot was carried in a cast iron socket on a sliding block bearing on steel slides and guided by two transverse plates. The lateral traverse was 1in. on each side. There were no inclined planes or other form of controlling force. The Adams bogies with spring controlling force have already been mentioned. William Adams's patent was dated February 13th, 1865, but it had been anticipated by R. Stephenson and Co., who in December, 1861, prepared a design, due to their chief draughtsman, J. D. Wardale, for a 4–2–2 tank engine for the Metropolitan Railway, which was, however, not patented. In this design the bogie centre block was arranged with lateral sliding motion controlled by a volute spring on each side, the arrangement being identical in principle with that of Adams. This engine, the drawings for which were submitted to Mr. (later Sir) John Fowler, was not built. Copies of these drawings were published in the *Locomotive*, June, 1924. In 1864 Messrs. Stephenson built eight 4–4–0 tank engines for the Buenos Ayres Great Southern Railway, in which similar spring-controlled sliding bogies were used. The drawings for these engines were dated January, 1864. There is no reason for supposing that Adams had any knowledge of Stephenson's designs.

Tires.—By far the most important development in locomotive construction during this period was the substitution of steel for wrought iron tires, and it is not too much to say that express engines with coupled wheels became a practical success entirely as a result of this change, the credit for which is due to the steel manufacturer, and not to the locomotive engineer.

The old wrought iron tires were originally made of Staffordshire iron, and as loads increased and a better material was required Low Moor or Bowling iron was employed. But all iron tires were defective in that the soft material was squeezed out or crushed when the loads on the wheels exceeded very moderate limits. Wrought iron tires with steeled faces were tried by D. Gooch, Isaac Dodds, and others from 1840 onwards, but their success was sometimes doubtful, and they were stated to have been unreliable owing to brittleness. A steel bar was added to the pile from which the tire was rolled. This was worked to form the tread, but the chilling which occurred during shrinking not only affected the material detrimentally, but so hardened the treads that the latter had to be ground. Gooch seems to have altered his method of steeling the treads, for in D. K. Clark's description of the G.W.R. 4–4–0 tank engines of 1849 it is stated that the steel face was fixed to the iron body by means of dovetails and zinc joints.

Wrought iron tires were at first scarf welded, but double V welds and butt welds were afterwards used, the latter being preferred. The soundness of the weld was tested by means of a stretching block, but the tire smith on most railways put a mark on the edge of the tire on each side of the weld to locate its position and prevent the wheel shop from securing the tire by a stud or rivet in the region of the weld.

The first to make a weldless tire was the late Mr.

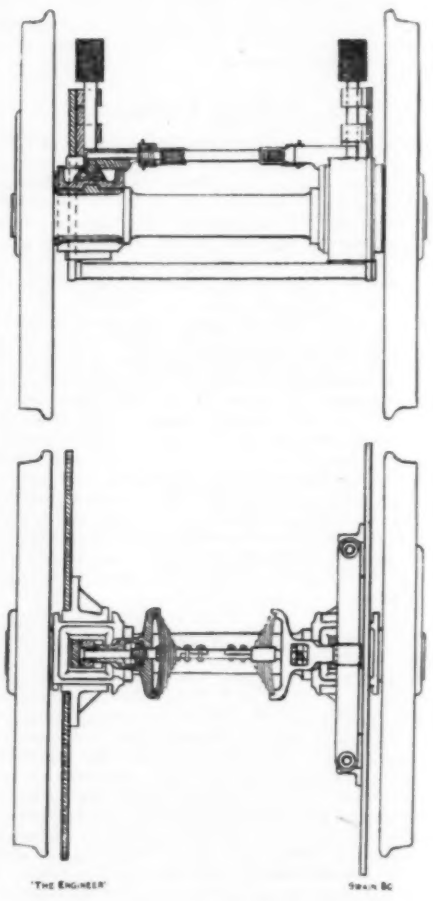


FIG. 173—CAILLET'S MOVABLE AXLE

(afterwards Sir) F. Bramwell in 1844, when he was manager of a railway carriage works. A coiled wrought iron hoop was wound helically round a barrel and then welded into a solid mass. It was then finished into a true and uniform ring by the continuous rolling process introduced about 1839–40 by G. R. Bodmer. Bodmer's tire rolling mills were at that time made by P. R. Jackson, of Salford, though they were not intended by the inventor for making weldless tires, but to use rolling as a finishing process, leave a hard skin on the tread, and avoid turning the tire in a lathe.

In 1855 Bramwell's method of manufacturing weldless wrought iron tires was taken up by Owens' Patent Wheel and Axle Company, of Rotherham, and also by a firm in France, though the first tires made on this system to a large scale did not come on to the market until about 1861. Owing to the improvements in steam hammers the helical hoop was now hammered down in dies. For tires 5in. wide the unwelded hoop was about 12¼in. to 15in. high, and its diameter about one-half that of the finished tire. Whether large driving wheel tires were made on this system the writer has not been able to ascertain definitely, but in 1863 Kitson, of Leeds, was rolling weldless wrought iron locomotive tires, which were fixed to the wheel centres by means of a hooked lip without using studs.

Early attempts at making welded steel tires in this country had naturally been made, but the material then tried was of such a nature that a sound weld could not be relied upon. The first successful steel

* No. XXI. appeared May 22nd.

[1] Heusinger v. Waldegg, "Handbuch für Specielle Eisenbahn Technik."

[2] "Proc.," Inst. C.E., Vol. 23, 1864.

locomotive tires were manufactured by Krupp, of Essen, in 1851 (according to W. P. Marshall), and before 1860 Krupp's tires had made considerable progress in Germany and France. When steel tires were first used for locomotives in this country the writer has been unable to trace exactly, but it was probably about 1859 when Naylor and Vickers, of Sheffield, supplied some to the L. and N.W.R. The same firm delivered steel tires to the G.N.R. and M.S. and L.R. in 1860, to the N.E.R., N.L.R., and G. and S.W.R. in 1861, and to the Midland and the Great Southern and Western (Ireland) railways in 1863. Robert Sinclair's G.E.R. 2–4–0 engines, built by Messrs. Stephenson in 1861, the Caledonian 8ft. 2in. express engine, and the Crewe-built Lady of the Lake, all of which were shown at the 1862 Exhibition, had tires of Krupp steel. Krupp's tires were also used for the Metropolitan 4–4–0 tank engines of 1864, and on the Midland 2–4–0 fast passenger engines of 1867. But the smaller railways appear to have been quite as much to the fore in their adoption of steel. On the Taff Vale, under Joseph Tomlinson, the change from iron to steel began in 1861, and after 1863 no iron tires were used except for tenders. The Maryport and Carlisle Railway also adopted steel about 1862.

There were several methods of making steel tires. Krupp made a square bloom of crucible cast steel, which was drilled through in two places, and the holes opened out into a single aperture. The bloom was then reheated, reduced to a circular shape under the hammer, and finally shaped in the rolls. Naylor and Vickers introduced the process then used at Bochum in Westphalia, and made crucible tires in moulds. The method of casting was then kept secret, but it was commonly understood that the moulds were highly heated and the castings allowed to cool in them very gradually. Six tires were cast together, one above the other, and then separated by a saw; each was then finished to size and contour in the rolls. Both these processes were very expensive.

When the Bessemer process was first used the material was such that welded tires could be made. This method was soon discarded and replaced by one in which a large ingot was hammered into a cylindrical form and cut into discs, which were reheated, punched, and rolled in a Galloway tire machine which finished the tire in one operation at the second heat. About 1864 Messrs. George Brown and Co., of Rotherham, also brought out an improved tire rolling mill, which seems to have ante-dated the rolling in use at Bessemer's works.

The first tire rolled on this machine was made of wrought iron puddled into a ball and punched, and the event is stated to have created some stir. An Irishman accepted a wager to bowl this tire from Rotherham to Doncaster and back, and more than 100 persons accompanied him on the journey. The manner of entry of this tire into Doncaster appears to have been somewhat unorthodox, seeing that the railway had no part in the proceedings.

The later usual method of hammering a steel ingot, cutting off the end, and punching a hole to allow it to be rolled into a finished tire followed immediately, and Messrs. Henry Bessemer and Co. appear to have been the first to adopt this plan. There is, however, much in the history of steel tire making between 1851 and 1865 which is still obscure.

In 1866 the L. and N.W.R. erected a Bessemer plant at Crewe under J. Ramsbottom's supervision. The ingots were cast in the form of solid short cones, which were then hammered in a special duplex hammer invented for the purpose. The resulting short conical disc was by this method consolidated in the centre, through which it was punched and afterwards rolled. To test the material at Crewe some of the bored tires were made red hot and shrunk on to solid cast iron wheel centres. It was stated that no cases of fracture occurred.

There appears to be no information as to the tensile strength of English steel tire material of the days before 1868, in which year the Steel Committee tested steel bars of hammered tire material, of which Bessemer steel showed a mean "elastic strength" of 23.3 tons per square inch, ultimate strength 35.09 tons per square inch, with an extension of 11.1 per cent. Crucible steel gave a mean "elastic strength" of 20.62 tons per square inch, ultimate breaking strength 35.51 tons per square inch, with an extension of 9.17 per cent.

When the writer was at Swindon a number of tires originally put on in 1868–1871, which had run long mileages, were removed, and afterwards tested and analysed. The results are given in the annexed table. The high tenacity of the Krupp tire may be noted.

The results given by steel tires, as regards wear and mileage, compared with iron tires were very marked. The Great Eastern 2–4–0 engines of 1861 with Krupp tires were stated to have run 60,000 to 70,000 miles without being re-turned. One pair ran 68,000 miles for ¼in. wear on the treads. In the case of Midland engines of the 1867–1871 period, William Kirtley, afterwards locomotive superintendent of the L.C. and D.R., stated that with the heaviest engines only 50,000 to 60,000 miles could be obtained with iron tires, crucible cast steel tires gave a mileage of 120,000 to 150,000, the tires having a thickness of 2¾in. when new. The softer Bessemer steel tires ran about two-thirds of the mileage of the crucible steel tires.

Although the locomotive superintendents were glad enough to avail themselves of the harder material and so keep their engines out of the shops, there were some countervailing disadvantages. There was a considerable number of tire fractures; a peculiarity of some of these being that the tires broke into several pieces, which were thrown off to a considerable distance. Many, though not all of these occurrences, took place in frosty weather, and for a long time it was held that frost had a detrimental effect on the material of the tire. The writer considers that the breakages were due to other primary causes. First, the shrinkage allowance at that time was settled by rule of thumb, and there were probably very many cases of tires shrunk on too tightly, and put to work in an overstressed condition. A tire snapping from this cause alone would naturally be expected to break in one place only. But, in addition, there probably was a lack of suitable heat treatment, and work was done on the tires at critical temperatures. If these two primary causes were combined with the secondary effect of frost, not on the tire itself, but in making the road bed hard and unyielding, it is conceivable that a sudden lateral blow, acting upon a brittle and already overstressed tire, might cause it to break in several places. Several such breakages occurred in the case of the tires of leading wheels. An additional likely cause may have been the presence of excess of phosphorus, which would make the tire brittle at low temperatures.

Steel Tires of 1868–1871.

Maker.	Nature of steel.	Date put on.	Dia. of driving wheels.	Weight on driving wheels (pair).	Total mileage.	Tensile test.			Chemical analysis.				
						Breaking stress per sq. in. on original area.	Elongation % in 2".	Contraction of area.	C.	Si.	Mn.	S.	P.
			ft. in.	t. c.									
Vickers ..	Crucible	Oct., '68	5 9	11 10	411,349	L 37.65	21.5	32.7	.34	.11	.13	.02	.059
						X 35.36	15.1	23.7					
Cammell ..	Bessemer	Apl., '68	5 9	12 0	344,147	L 36.01	24.65	43.4	.34	.033	.46	.058	.037
						X 35.51	10.0	11.1					
Cammell ..	Bessemer	Sept., '69	5 9	12 0	273,087	L 37.88	20.77	31.73	.36	.063	.418	.056	.021
						X 36.53	15.0	26.88					
H. Bessemer	Bessemer	Nov., '69	6 0	10 10	301,135	L 35.78	20.13	28.69	.45	.013	.375	.08	.05
						X 12.86	?	11.56					
Krupp ..	Crucible	'71	5 9	16 18	193,447	L 49.4	17.6	23.1	.52	.271	.468	.037	.086
						X 44.7	5.0	5.6					

L, Test piece along the tire. X, Test piece across the tire.

The first four tires were taken off 2–4–0 tender engines of the G.W.R. The fifth (Krupp) tire was removed from one of the Metropolitan District Railway 4–4–0 tank engines, and owing to the sharp curves on that line, and the heavier weight on the wheels, underwent much more severe service.

Steel Axles and Motion Parts.—In the use of steel for axles and motion parts, as in the case of tires, continental locomotive constructors were ahead of those in this country. It is but fair to add that there was a greater incentive to use steel abroad, where, except perhaps in Sweden, there was no iron of the special and extremely high quality of the Low Moor, Bowling and Farnley brands, which, for locomotive purposes other than tires, had proved in every way satisfactory to British engineers. The purity of Yorkshire iron was chiefly due to the absence of sulphur in the "Better-bed" coal, which lay in the district. There was, therefore, very great reluctance in this country in giving up such reliable material for the more uncertain steel of that day. Moreover, continental engineers, who were building larger engines for freight and mineral trains, were striving to reduce the detailed weights and turned to steel as the best means of effecting this end.

At the 1851 Exhibition in London Krupp showed steel axles. When steel axles were first used in British practice the writer has been unable to determine. The Caledonian Railway provided "cast steel" straight driving axles for the large 2–2–2 engines, with 8ft. 2in. driving wheels, about 1860. They were made at St. Rollox, but subsequently a number broke in service, though this may possibly have been due to insufficient diameter. On the Taff Vale Railway from 1863 onwards, Joseph Tomlinson used either "cast" or Bessemer steel for all axles except crank axles. Messrs. Vickers made forged steel crank axles in 1865, and in 1866 supplied them to the S.E., L.C. and D., and L. and Y. railways. The London and North-Western Railway adopted Bessemer steel crank axles about 1866, and some of Sturrock's Great Northern engines of the same period had Krupp steel axles. But for many years there was considerable distrust of steel crank axles, except perhaps on the L. and N.W.R., and it was nearly twenty years before they were generally considered to have "made good." It is probable that much of the distrust was due to the lack of "work" put into the early axles. The hammers, though large enough for forging wrought iron axles, were not always sufficiently powerful to affect the "core" of the steel axle, and only the surface metal received suitable "work," so that perfect homogeneity of structure was lacking The heat treatment was probably in many cases defective.

Referring to heat treatment, it may be of interest to refer to a locomotive by Borsig, in the London 1862 Exhibition. This engine had connecting, piston and coupling rods, crank pins and axles of Krupp steel. A letter by Borsig, published subsequently in Paris, stated that all these parts were, when forged, tempered by being heated in an air furnace to a red heat. After the "tempering," they were reheated to a cherry red, and cooled. Any bad material showed cracks, and was rejected. In mentioning this letter, the writer does not imply that the British steel makers of that day did not subject their steel to proper heat treatment, but whether all the railway and locomotive works fully understood the new material with which they were dealing is an open question, and they may not have been so thoroughly coached by the steel manufacturers as were the German locomotive builders.

The following direct tensile tests were made by Wöhler upon the axle steels, which he also tested under alternating stresses, and are of interest in that both German and English steels were then used for locomotive axles in this country.

Bars from steel axle by	Ultimate tensile strength, tons per sq. in.	Elongation, per cent.
Krupp, 1853	41.8	23.7 and 17.4
Krupp, 1862	48.98	12.1
Krupp, 1862	50.15	18.6 and 11.7
Bochum, 1863, average ..	42.27	18.65
Borsig, 1863	39.41	21.7
Borsig, 1863	37.26	22.3
Vickers, 1868	29.14	19.5
	26.27	15.8

The German figures have been reduced to British tons per square inch. The length of the specimens from which the elongations were derived was not given.

A test of Messrs. Naylor, Vickers and Co.'s axle steel made by Sir W. Fairbairn showed a tensile strength of 39.58 tons per square inch. Tests by the "Steel Committee" in 1868 gave the following results:—Hammered Bessemer steel axles: "Elastic strength," 21.87 tons per square inch; ultimate breaking strength, 33.47 tons per square inch; permanent extension, 12.1 per cent. Hammered crucible steel axles: "Elastic strength," 25.56 tons per square inch; ultimate breaking strength, 40.93 tons per square inch; permanent extension, 8.72 per cent. The specimens tested were 1.382in. diameter by 4ft. 2in. long, and therefore the percentage elongation figures are smaller than would have been obtained with shorter test specimens. The loose expression "elastic strength" is that used in D. K. Clarke's synopsis of the original report ("Rules, Tables and Data for Mechanical Engineers," 1878 edition).

In 1862 Robert Sinclair on the G.E.R. used Krupp steel for piston-rods, valve spindles, straight axles and crank pins, as well as for guide bars. He also used cast steel horncheeks and cast iron axle-boxes with chilled faces.

Axle-boxes and Journals.—To avoid the working loose of brasses when fitted into axle-boxes, the former were frequently cast in. Axle-box keeps were sometimes made to contain sponges or closely packed cotton waste, and in some cases the sponges were held up to the journals by springs. The writer cannot state definitely who introduced these improvements, but some of them were used by Sinclair.

Boilers.—In 1860 the Midland Railway, under Matthew Kirtley's superintendency, re-introduced welded longitudinal seams to replace the old lap-jointed seams. This practice coincided with an increase of pressure to 140 lb. The boilers were made of $^{7}/_{16}$in. Yorkshire iron plates in three barrel rings. The plates were rolled with thickened edges, tapering up to ⅝in., the length of taper being 4in., and similar thickened edges were used for the circumferential joints. The longitudinal seams were welded, all three rings being of the same diameter. The circumferential joints were strengthened by outside double-riveted butt strips, and in addition hoops were shrunk over the middle of each ring, crossing the welded joints and being secured by a few rivets. Hoops and covering strips were blocked before being shrunk on, and all rivet holes were drilled with the hoops in place. The rings were made in two semi-circular portions, so that two longitudinal welds were necessary for each ring. The weight of a boiler 11ft. long by 3ft. 11in. inside diameter was 7¾ tons with the new welded joints, as compared with 6½ tons for the old construction, and the cost was about 12½ per cent. greater. Tests of strips showed that the original plates had a tenacity of 23.6

tons and the welded portions 20.6 tons per square inch. After trials with nineteen boilers lasting over six years the welded boiler was adopted in 1866 as standard, owing to the lessening of repairs necessitated by grooving, but welding was discontinued a few years later, except in the case of the middle ring, on which the dome was placed.

Owing to their great length, Cudworth's fire-boxes from 1860 were provided with transverse in place of longitudinal roof girder stays. Generally, alternative girders were slung on each side from tee irons attached to the casing. This was probably the earliest application of transverse girders, but whether sling stays were then new the writer is unable to state. Cudworth also used tilting grates at the tube plate end.

The earliest steel boilers were made in 1862 and 1863 for the Maryport and Carlisle and the L. and N.W. railways, in the latter case at Crewe. The Crewe boilers seem to have been experimental, since Low Moor iron was still being used for some years afterwards. The L. and N.W.R. engines carried only 120 lb. pressure until about 1872. Steel boilers were looked upon with even greater suspicion than steel crank axles. The plates pitted much more rapidly than those of wrought iron, and generally their behaviour was far from satisfactory. A. Allan tried steel fire-boxes on the Scottish Central Railway during 1860–1863. From about 1862 the boilers for the Maryport and Carlisle Railway had steel fire-boxes and tubes made by D. Adamson and Co., of Hyde, for engines built by Mr. Tosh, locomotive superintendent at Maryport. They appear to have lasted for several years.

The rigid fastening of the motion plate to the barrel was dispensed with, but it was still thought advisable to carry the plate up to the boiler to give the latter support in the saddle formed by the double angle irons. A rubbing plate was sometimes riveted to the boiler, to protect it when sliding in the saddle.

Fittings.—The most important detail with the exception of steel tires was the injector invented by Giffard in France in 1859. The patent rights were taken up in this country by Sharp, Stewart and Co. in 1860, and some notes regarding the invention were given in THE ENGINEER of August 31st, 1923, page 231. It was adopted at once by most railways, though many locomotives were for a time also provided with feed pumps in case of emergency. As soon as the new appliance had proved itself the pumps, except in the case of Beattie's South-Western engines, were soon discarded. Engineers were not sorry to get rid of them, especially the crosshead-driven type. Apart from their inability to feed the boiler when the engine was standing, the hydraulic ram action when working at high speeds caused many bursts of both pumps and pipe connections. W. Stroudley at a later date re-introduced crosshead pumps on the Brighton engines to deal with hot feed water, and Professor Goodman, experimenting with them, found that the pressure sometimes amounted to 3500 lb. per square inch. It was reduced to 900 lb. per square inch by enlarging the capacity of air vessels and pipes to five times the capacity of the pumps, but further enlargement failed to reduce it materially below this point.[3]

Clack boxes were generally fixed to the front or middle ring of the boiler, but P. Stirling, on the Glasgow and South-Western Railway about 1861, when fitting his engines with injectors, delivered the feed into the water spaces at the sides of the fire-box immediately above the foundation ring. Judging from the fact that the clack boxes re-appeared on the boiler barrel shortly afterwards, the fire-box side delivery appears to have left something to be desired, though in the first G.N.R. 8ft. singles the clack boxes were also fixed on the sides of the fire-box casings.

Roscoe's well-known displacement lubricators came out in 1862. The inventor was district superintendent at Leicester (M.R.). Within a few years all Midland engines, as well as many on other railways, were fitted with them, and for about twenty-five years they were almost universal. The principle was similar to that of Ramsbottom's lubricator, but the steam entered the side of the oil vessel near the top instead of through a vertical tube through the bottom.

Screw Reversing Gear.—The credit for this invention is due to John Ramsbottom, who first applied it to the "Lady of the Lake" 2–2–2 engines at the end of 1859. The design is shown in Colburn, Plate II. Sinclair adopted it about 1862, but the design, which had a catch on the hand wheel, was different. This arrangement was designed by the late Dr. W. H. Maw, and was extensively copied on the Continent, both in Germany and France.

UNDER a by-law recently passed, an important extension, says the *Canadian Engineer*, will be made to the waterworks system at Vancouver, B.C. The scheme provides for the construction of about 13 miles of steel pipe line from the present intake on the Seymour Creek to the reservoir at Little Mountain, including a submerged pipe crossing the Burrard Inlet at the Second Narrows. The intake will be about 7 miles north of Burrard Inlet and the reservoir is situated at about an equal distance south of the Inlet. The work also includes a tunnel approximately 700ft. long to tap the waters of Burwell Lake at a depth of about 120ft. in order to control and regulate the flow of Seymour Creek during low-water periods.

[3] Goodman, "Mechanics Applied to Engineering."

Steam Regeneration: Its Possibilities.

By C. O. TOWLER.

SEVERAL attempts have been made, mainly in the remote past, to effect a saving in fuel in steam power plants by returning the exhaust steam to the boiler as steam and without condensing it into water. It would be superfluous to discuss the reason for their failures, as, in the majority of cases, the exhaust steam was intended to be returned by means of either a pump, or an injector, the injector being supplied by live steam from the boiler itself or from a supplementary boiler.

If a low-pressure fluid is to be admitted freely into a high-pressure system there must exist in that high-pressure system a portion constantly maintained at a pressure below that of the low-pressure fluid. Such conditions are attained in practice by means of the Venturi tube in which the pressure energy of a fluid is partially converted into kinetic energy with a consequent drop in pressure.

In experiments carried out by the writer this system was successfully applied to a steam boiler, and a portion of the boiler was maintained at a pressure lower than that at which steam was generated. These results were obtained by using short tubes closed at one end in place of the usual boiler tubes open at each end.

From experiments using a short glass closed-ended tube, it has been observed that until boiling point is reached, a circulation is maintained, water flowing in at the bottom and out along the top of the tube, as indicated by the arrows in Fig. 1. As soon as boiling point is reached, however, bubbles of steam begin to

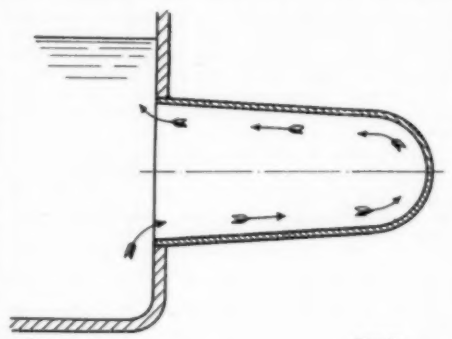


FIG. 1

form along the bottom of the tube. These bubbles steadily grow until practically the whole of the tube is filled with steam. Then the water in the container forces out the steam, the tube becoming again filled with water, and the operation is repeated. Under more intense heat, the rapidity of the operation increases, and eventually takes the form of vigorous pulsations, water flowing in and steam flowing out. When the pulsating has once commenced the action can be readily visualised:—Water rushing into a closed-ended tube and coming into contact with the hot sides is spontaneously converted into steam. The sudden increase in volume, in effect, produces a miniature explosion and empties the tube of practically the whole of its contents, water rushing in again.

By restricting the orifice of the tube and thus giving the water and steam a greater velocity at this part, a section of the tube is maintained at a pressure lower than that at which steam is generated. The apparatus used to verify the above supposition is

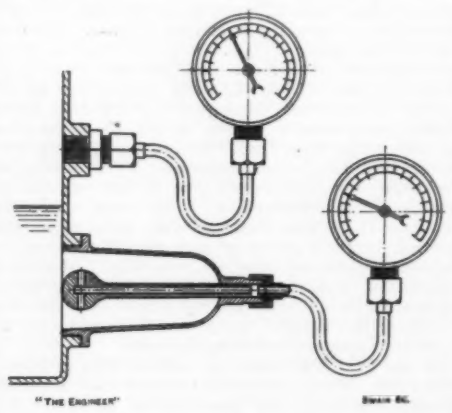


FIG. 2

illustrated in Fig. 2. While the pressure in the boiler was 40 lb. per square inch, that at the restricted portion of the tube was 25 lb. per square inch, giving a pressure difference of 15 lb. per square inch. As the flow in the tube reverses twice per pulsation, the velocity of water and steam is not constant, and the pressure difference must be a mean value, although no fluctuation on the gauge was discernible.

Further extensive experiments are necessary to determine the maximum mean pressure difference obtainable. It will vary according to:—

(1) Number of pulsations per unit time.
(2) Temperature of the furnace.
(3) Pressure at which steam is generated.
(4) Reduction in cross sectional area at the orifice of tube.
(5) Dimensions of the tube.

In dealing with each case it is assumed that the remaining factors are constant.

(1) The loss of pressure at the throat of a Venturi tube is proportional to the square of the velocity of the fluid, and as the velocity in this case is directly proportional to the number of pulsations, the difference of pressure obtainable will vary as the square of the pulsations per unit time.

(2) The greater the temperature of the furnace, the greater the flow of heat into the tube, with a consequent increase in the rapidity of the pulsations.

(3) The difference in temperature between the furnace and the contents of a boiler is greater in a low-pressure boiler than in a high-pressure boiler. If the furnace temperature is the same in each case, the amount of heat taken in by a low-pressure boiler tube is greater than that taken in by a high-pressure boiler tube. A low-pressure boiler tube would, therefore, be capable of creating a greater pressure difference than a high-pressure boiler tube.

(4) The ratio of the throat area to that of the rest of the tube may be varied within limits. The greater the ratio the greater the pressure dufference, but should the orifice be so small as to restrict the flow too much, a burnt tube might result.

(5) The effect of varying the dimensions of the tube has yet to be ascertained. Probably, within limits, the variation would have little effect upon the pressure other factors being constant, but a tube of larger dimensions would necessarily take in more heat than one of smaller dimensions.

In applying the principle to return exhaust steam to the boiler, if all the exhaust steam is to be returned, in order to maintain the pressure in the boiler constant, a tube must be designed so that the amount of heat taken in per unit time by the tube is equal to the difference between the total heat of the quantity of steam taken in during the same period at the pressure of the boiler and the total heat of the same steam before entering. This neglects radiation losses and assumes that all the heat taken in by the boiler is absorbed through the tubes.

Assuming that a particular tube is capable of taking in 15 B.Th.U. per minute and creates a pressure difference of 20 lb. per square inch, the tube being fed with dry exhaust steam at a pressure of 30 lb. per square inch, then the amount of exhaust steam to be fed into the tube per minute must be 1.546 lb., deduced as follows:—

	B.Th.U.
Total heat of 1 lb. dry steam at 50 lb. per square inch	1173.6
Total heat of 1 lb. dry steam at 30 lb. per square inch	1163.9
Difference	9.7

Pounds of steam raised from 30 lb. per square inch to 50 lb. per square inch per minute $= \frac{15}{9.7} = 1.546$.

To raise the pressure of steam to a degree sufficient for the efficient working of a power plant would require either a series of separate boilers or a composite boiler consisting of a number of independent sections, each section forming within itself a boiler, exhaust steam being led to the first, and each subsequent section or boiler being fed by steam from the preceding boiler. In all probability in such a composite boiler, the sections in closest proximity to the furnace where the temperature is highest would be capable of producing a pressure difference of from 40 lb. to 50 lb. per square inch.

As the majority of tubes in such a steam-raising plant would be fed by dry steam from a preceding boiler, the assumption has been made in the foregoing calculation that the exhaust steam was dry. In any case, this condition of the exhaust steam could be easily attained by means of an "economiser" utilising the waste heat in the gases leaving the boiler.

A composite boiler working on the principles outlined above adapts itself to a multiplicity of designs, the vertical type probably having the advantage in simplicity.

A diagrammatic view of one type of vertical composite boiler is given in Fig. 3. The furnace is not indicated, but is intended to be at the bottom, the products of combustion passing up the centre of the boiler. Each section is divided into two chambers, an outer or main chamber, containing water and steam under pressure, and a feed reservoir. The closed-ended tubes are secured to the walls enclosing the feed reservoir, the closed ends projecting into the flue passage and the open ends communicating with the main chamber. Exhaust steam is fed into the receiving chamber A at the top of the boiler, and passes through holes B into the feed reservoir C of the first section. Communication between the feed reservoir and the closed ended tubes is through holes in the tubes at the section of low pressure, through which the exhaust steam flows and mingles with the contents of the main chamber at higher pressure. Steam is conducted away from the main chamber by means of an anti-priming pipe D, and led to a chamber

E between the first and second sections, and from there through holes to the feed reservoir of the second section. Steam would be led from the last section to the engine through a superheater—not shown in the diagram.

Should it be found impossible to return the whole of the exhaust steam to the boiler, the water level in the first section must be maintained by means of a pump or injector, or, if the exhaust pressure is so low that the pressure in the main chamber of the first section is equal to that of the atmosphere, then the water level may be maintained by direct connection with an external tank, the level of which is kept constant by means of, say, a ball float valve. Each succeeding section would take its feed from the preceding section. In no case would cold water strike against a hot plate, and in the high-pressure sections the difference in temperature between the contents of the section and the entering water would be negligible as far as deleterious effects are concerned. Any solid matter in the feed water would be deposited in the first section only; the other sections would remain perfectly clean.

It would be impossible to construct a boiler of this description such that the heat absorbed by each section was exactly proportional to its requirements. In order to maintain the exact ratio of pressure

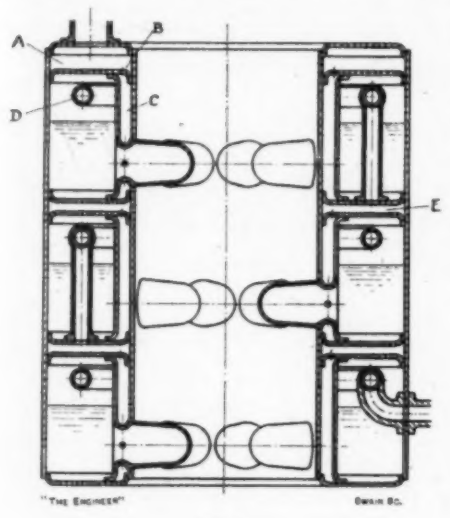


FIG. 3

between two consecutive sections to ensure efficient working, each section would be connected to its preceding section through a reducing valve, and if the last section, that is, the one working at highest pressure, were given an excess of heating surface, the pressure throughout the entire boiler would be self-adjusting.

The writer is convinced that steam regeneration on the principle roughly outlined above, is quite a practical proposition, and would result in a considerable saving of fuel, thus forming a big step towards cheap power with its consequent beneficial effect towards industry.

Institution of Mechanical Engineers.

An extra general meeting of the Institution of Mechanical Engineers was held in London last Friday evening for the presentation of a paper, entitled "Some Tests on a Two-stroke Cycle Oil Engine," by Professor E. A. Allcut, of the University of Toronto. Professor Allcut was present in person to read his paper. The two-stroke cycle heavy oil engine, with crank case compression, had, he remarked, advanced considerably in popularity in recent years for use in installations on which the demand for power was too small to be satisfactorily met by a "Diesel" engine. Although the peculiar features of the two-stroke cycle had been dealt with by Sir Dugald Clerk and others, few records were available of actual complete tests on engines of the type. The object of his paper was to supply such a record,

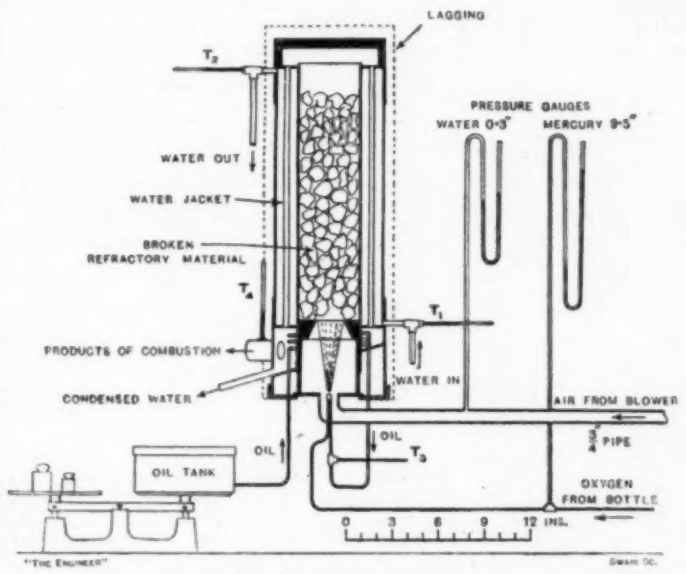
TESTS ON A TWO-STROKE OIL ENGINE.

The engine tested by Professor Allcut was one supplied to the Thermodynamics Laboratory of Toronto University by W. H. Allen, Sons and Co., Ltd., of Bedford. It has a single cylinder, 9½in. in bore and 11in. in stroke, and at 375 revolutions is rated to produce 25 brake horse-power. It is equipped with hot-bulb ignition, has crank-case compression, and is supplied with fuel oil by a pump the stroke of which is regulated by a governor to suit the load on the engine. For each test the engine was started up on paraffin, and was changed over to fuel oil after about ten minutes had elapsed. No readings were taken until the engine had been running for at least sixty minutes under steady conditions. Details of the test equipment will be found in the paper, but, with the exception of the oil fuel calorimeter to be described later, we need make no reference to them here.

From a study of the indicator cards, it was found that for the expansion curves the coefficient n in the formula $P V^n$ = constant varied from 1.13 to 1.04, the lower value being characteristic of the heavier loads. The compression curves varied little in form, the average value of n being 1.33. Light-spring and crank case diagrams showed that the compression curve started practically from atmospheric pressure. On the no-load test firing did not occur on all the strokes. The pencil was kept on the indicator paper until a diagram was obtained and the mean pressure, deduced from such diagram, was multiplied by the ratio of firing to total cycles to give the true mean effective pressure at no load. The percentage of non-firing strokes in the no-load test was 64.4 of the total number of cycles, and the deduced indicated horse-power 4.02. The crank case compression absorbed 1.48 horse-power, so that the net indicated horse-power was 2.54, a value closely agreeing with the difference between the indicated and brake horse-powers in the other tests.

At heavy loads the combustion was found to take place at practically constant volume, but at light loads many of the cards showed slow combustion as a result of the poorness of the charge. Late ignitions were observed in some preliminary tests, but after the injection had been advanced about 6 deg., no late ignitions were observed, and, in addition, the fuel consumption was reduced, in one instance by as much as 14 per cent.

The mechanical efficiency varied from 78 to 85 per cent., and the thermal efficiency from 24 to 27 per cent. After allowing for the kinetic energy in the exhaust products, there remained a balance of 8 to 10 per cent. in the heat account for the tests under load. This balance included radiation and the heat value of any fuel escaping unburnt through the ports. In the no-load test, the unaccounted-for balance



CALORIMETER FOR TESTING FUEL OIL

was large, and it is suggested that it is to be explained by the fact that when explosions were missed the oil delivered into the cylinder was insufficient to form an explosive mixture and escaped unburnt through the ports.

On analysing the exhaust gases it was found that only from 50 to 68 per cent. of the carbon in the fuel could be accounted for. It would appear that the discrepancy is to be accounted for by the failure of the gas-sampling means employed to take proper account of the first puff of carbon-rich exhaust gas leaving the cylinder at a high velocity.

In an appendix to the paper the author describes a special calorimeter designed to test the fuel used in the experiments. This calorimeter illustrated herewith is distinguished by the fact that it contains a body of refractory material, which, when raised to incandescence, promotes surface combustion on the "Bonecourt" principle. The material used was calcined magnesite. The body of the calorimeter is a copper vessel, 14in. long and 4in. in diameter. The products of combustion return to the bottom through water-jacketed tubes. The oil is introduced at the foot of the vessel through an atomising sprayer of the type used in medical work, the fuel supply pipe being connected by rubber tubing to a tank mounted on weighing scales. The air jet of the sprayer was connected to an oxygen bottle, but satisfactory combustion was not obtained until—as shown in the engraving—a supply of extra air was delivered to the outside of the jet by means of a motor-driven blower. It was found that with proper regulation of the air and oxygen supply, a perfectly smokeless exhaust could be obtained. Particulars are given of the final design of calorimeter evolved. In this design the combustion chamber is moulded in carborundum, and a glass inspection door is provided to permit the conditions of combustion to be examined. A pre-heating coil is arranged at the top of the body, whereby the viscosity of heavy oils may be reduced before they reach the burner.

In another appendix an account is given of some investigations on the flow of oil through small orifices made in connection with the design of the calorimeter. In a third appendix some tests are described on the degree of atomisation obtained with the calorimeter sprayer when different air pressures were used. The method of experiment consisted of receiving the spray on a glass slip placed about 6in. above the nozzle and examining the globules under a microscope with a magnification of 30 diameters. With an air pressure of 4in. of mercury—2 lb. per square inch—the splitting up of the oil was by no means uniform. Higher pressures up to 10in. of mercury were only partially successful in producing pulverisation into very small drops, large globules being intermixed with the small. In general, the higher the air pressure, the smaller were the diameter of the largest drop and the average diameter of the large drops.

Mr. A. E. L. Chorlton, called upon by the President to open the discussion, confessed to finding a difficulty in discovering with what the paper was primarily concerned. There was more in it, he said, about the calorimeter and the other instruments used in the tests than about the engine and the test results which it gave. In the second-named connection, the most striking feature of the results was the high mechanical efficiency recorded. That efficiency was quite 5 per cent. above what was usual in the type and size of engine tested. He suggested as an explanation that the main indicator cards were not accurately representative of what was taking place in the cylinder. It was very difficult to indicate a high-speed engine of the type tested, unless an indicator of the Farnborough spot form were used. Turning to the question of exhaust gas analysis, he remarked that such analysis usually gave a different result each time it was repeated on the one sample, and it was not to be wondered at that there was a considerable discrepancy between the carbon in the fuel and that detected in the exhaust. Even in the Humphrey pump, his own firm—Beardmore's—did not know quite what to make of the exhaust analysis figures. The values given by Professor Allcut for the index n of the expansion and compression curves were, it should be noted, not of necessity applicable to other engines, for the value varied with the type of engine and the manner of charging. Dealing with the engine itself, he said he was unaware whether its makers regarded it as being up to date. Comparing it with another engine of the same type, he remarked that the mean effective pressures recorded by Professor Allcut were very low, 22 lb. to 37 lb., as contrasted with a normal mean of about 42 lb. and, as lately achieved, with a record mean of 53 lb. Similarly, the consumption of fuel per indicated horse-power hour was not very good. The best recorded by Professor Allcut was 0.476 lb., and the maximum 0.541 lb. These figures were quite 10 per cent. higher than those obtained in the other two-stroke crank-case compression engines, to which he had referred. In the engine giving 53 lb. mean effective pressure, the consumption per indicated horse-power hour was about 0.45 lb., and in one case on a more or less snap test 0.42 lb. had been recorded. Doubtlessly, the engine tested by Professor Allcut would have shown better results had the makers been able to tune it up properly before the tests. Replying to a question interjected by the author, Mr. Chorlton made it clear that the 53 lb. M.E.P. engine to which he had referred had a very much higher compression pressure than Professor Allcut's—about 400 lb., as compared with 128 lb.

Mr. J. L. Hodgson dealt with the author's investigations of the flow of oil through small orifices. All the data required for analysis were not given, but from the study he had made of the recorded results, he had come to the conclusion that a considerable error had crept into the figures. The discharge was not, as was usual, proportional to the pressure in the oil, and he wondered whether the gauges employed had read correctly, whether the thin sheets in which the orifices were formed distorted under the applied pressure, or whether the phenomenon were really a true one.

Mr. F. H. Livens said that the chief characteristic of the type of engine tested by the author was simplicity of construction rather than economy of running, and the makers were generally content that it should be so. On small loads such engines were not easy to run satisfactorily, and for that reason no doubt the author did not record any output test below 13 brake horse-

THE GUILLEMARD RAILWAY BRIDGE OVER THE KELANTAN RIVER

power, or about half the maximum rating. The oil used by Professor Allcut was one that should have been very favourable to the performance of the engine. It was not so heavy as the oil that would have been used in this country on a similar test. He agreed with Mr. Chorlton that the recorded mechanical efficiencies were very high, and said that the indicator cards of a two-stroke crank-case compression engine were difficult to obtain, and should be treated with much caution.

Captain H. R. Sankey, referring to the exhaust gas analysis and the fact that only 50 to 60 per cent. of the carbon in the fuel had been accounted for in the exhaust, said that a similar discrepancy could be detected in the exhaust gas temperature. It was very difficult to measure the exhaust temperature in a satisfactory manner. That difficulty had been encountered in the tests conducted by the Marine Oil Engine Trials Committee. In one case, the temperature of the exhaust as recorded by the thermometer was 598 deg., but on analysis it should have been 844 deg. in order to account for the heat in the gases. In another instance a recorded temperature of 526 deg. should have been 683 deg. The fact was that the temperature as measured in the exhaust pipe was not the temperature of the gases inside the cylinder at the moment of exhaust. Turning to the author's design of calorimeter, he stated that it had attracted the attention of the Heat Engine Committee because it enabled the lower calorific value to be determined in a direct manner without requiring the services of a specialist.

Captain King suggested that the difficulty of measuring the calorific value of a heavy fuel oil might be overcome by mixing 50 per cent. of petrol with the oil. That method, he said, had been tried and had been found to be satisfactory and readily applicable.

Mr. A. L. Bird stated that at Cambridge University there was an exactly similar engine to that experimented with by Professor Allcut. For the purpose of analysing the gases a sampling valve was fitted to the indicator hole. This valve could be operated at any point in the engine cycle. At an output of 17½ horse-power 4.7 per cent. of carbon dioxide was found in the gas inside the cylinder during the exhaust stroke, as compared with 4 per cent. in the exhaust pipe. During the compression stroke 0.5 per cent. of carbon dioxide at the most was detected in the cylinder charge. He believed that the indicator hole, being above the inlet port, the rush of scavenge air caused the true mixture of the gases to be obscured. Turning to the author's experiments on the atomisation of oil, he said that he had recently conducted similar experiments with orifices in plates 0.005in. thick, the orifices being formed and clamped in such a way as to permit of their size being varied. Using an injection pressure of 2000 lb. per square inch he studied the distribution of the drops as projected against a sheet of white glass. Plotting the number of particles per square inch against the distance they were projected, he found that the curve obtained showed a rapid rise to a maximum followed by a rapid and then a slower fall. The heaviest particles had an average diameter of about 0.01in. and travelled the farthest. In the neighbourhood of the maximum point on the curve the particles had a diameter of about 0.003in. Near the origin the particles had a diameter of about 0.001in. Altogether 0.02 gramme of oil gave, it was estimated, 17,500 drops or particles.

Mr. C. W. J. Taffs said that the author had plotted the mechanical efficiency of his engine as a straight rising line, but it could equally fairly be deduced from the plotted points that the line was a curved one with a maximum value somewhere along its length. The fuel consumption per horse-power hour was shown to be a minimum at about 17 to 18 brake horse-power. It was usual, however, to find the minimum consumption at some point after the rated power of the engine had been reached, which would be about 30 horse-power in the case of Professor Allcut's engine. The analysis of the exhaust gas temperature records referred to by Captain Sankey related to the trials recorded in the first report of the Marine Oil Engine Committee. A similar analysis of the second report figures revealed results still more anomalous.

Mr. R. W. Allen said that the Imperial aspect of Professor Allcut's paper chiefly impressed him, for it was surely exceptional to find a Canadian professor giving in this country the benefits of his experience on a British engine. He trusted that the precedent set by Professor Allcut would be followed by others in Canada and other parts of the Empire. Dealing with the test results, he expressed some doubts as to whether the figures for oil consumption per brake horse-power hour were correctly recorded in view of the fact that the best consumption occurred at less than the maximum power.

Mr. J. L. Chaloner did not agree with the statements made that the best fuel consumption of an engine occurred at the maximum horse-power. It was generally found at 0.8 to 0.85 of the normal rated horse-power. The engine tested was said to be rated at 25 brake horse-power. If that output represented the maximum and not what the engine would give continuously then the point of best fuel consumption found by the author would be about correctly positioned. The fuel used by the author was no more fuel oil than kerosene was petrol; it was a very good gas oil, and that fact should be borne in mind when the results were being examined. Perhaps the fuel was too good, for with too high a grade of oil there was a danger of combustion being retarded. The author's atomisation experiments were, he said, useless, for the conditions stood in very little relationship to those in an actual engine. Professor Allcut's calorimeter, as recorded in the paper, gave results differing only by 1 per cent. or so from those obtained with a Mahler bomb calorimeter. He did not believe that the experiments as a whole could be claimed to have an accuracy that would be affected by the discrepancy between the two calorimeter figures.

Mr. W. H. Patchell dealt with the question of higher *versus* lower calorific value. The higher value was becoming generally adopted partly because of the difficulty of determining the lower and partly because there was not one, but many, lower values. The author's calorimeter was of great interest, because it permitted the lower value for oil fuel to be obtained without the assistance of the chemist.

In replying to the discussion, Professor Allcut said that although Mr. Chorlton had criticised the title of the paper, he thought that it was fairly indicative of the contents. The main object of the tests described was to find out what really happened in a two-stroke crank case compression engine, and the other investigations referred to in the paper were subsidiary to, but necessary for, the main purpose. Some doubt had been expressed that the mechanical efficiencies which he had given for the engine were too high. He admitted that the indicator cards had been taken with a pencil instrument and a stiff spring, so that any slight errors became serious. The results had, however, been confirmed by tests made subsequently by his students. As to the mean effective pressures, they certainly seemed low, but the pressures given were what he actually found them to be. If the pressures were low it was the fault of the engine rather than of his tests. The fuel consumption curve had been checked to prove that the minimum occurred at about 18 horse-power. Mr. Livens had remarked that the duration of the tests was too short, but, as a matter of fact, although observations were taken for only ninety minutes, the engine was run for one or two hours under steady conditions before the test and two trials were generally made each day, so that the engine was run continuously for five or six hours per day all told. In reply to Captain Sankey's remarks, Professor Allcut said that the temperature of the exhaust gases was taken at a spot 4in. from the exhaust ports of the cylinder, and the figures given were means and probably not the true means; he hoped, however, to obtain the exhaust temperatures and gas analyses simultaneously at different parts of the stroke. He advocated the more general acceptance of the higher calorific value of the fuel in making calculations, as the lower value, as commonly determined, was not so reliable. The use of his calorimeter for the purpose of determining the lower calorific value was, he had to point out, open to the trouble that the air leaving the calorimeter was in a different state of saturation from the air entering it, and that difference was not shown by the water collected. Professor Allcut promised a reply to other points raised during the discussion in writing.

Guillemard Bridge Over the Kelantan River.

By the courtesy of the Acting General Manager of the Federated States Railways, we are enabled to reproduce above a photograph of the Guillemard Bridge over the Kelantan River. This bridge, which was officially opened on July 19th, 1924, by H.E. the Governor of Straits Settlements and High Commissioner, Federated Malay States, Sir Laurence Nunns Guillemard, K.C.B., K.C.M.G., crosses the Kelantan River near Tanah Merah, Kelantan, and it has been called Guillemard Bridge to commemorate Sir Laurence's period of governorship. It is situated about 35 miles from Tumpat, the terminus of the railway in Kelantan, which line, when linked up with the line in Pahang, will form the east coast line, and give through connection between Singapore and the Siamese lines. The western line, *viâ* Kuala Lumpur, Penang and Kedah has been open for through traffic with Siam since 1918.

The Pahang–Kelantan line was commenced in 1912, but the work has been subject to interruptions. From 1914 to 1918 work was completely stopped on account of the war, and from 1921 till 1924 it was considerably slowed down on account of the financial situation. The work is now being pushed on vigorously over the whole length, and it is hoped that the line will be completed by the end of 1927. The total length from Kuala Lipis in Pahang to Tumpat in Kelantan is 187 miles, and of that length, 23 miles have been opened for traffic in Pahang and 53 miles in Kelantan.

The Guillemard Bridge is by far the largest bridge in the Malay Peninsula, and is 2166ft. long overall. It is composed of five clear spans of 250ft. and five spans of 150ft. The height from the river bed to the underside of girders is 55ft. The Kelantan River at the bridge site has a normal low-water width of 1100ft., but in the north-east monsoon it is subject to floods of 30ft. to 35ft. above the normal level, and the width increases to over 2000ft.

The bridge was commenced in 1920, and completed in 1924, but on account of financial circumstances progress was slowed down over a considerable portion of that period. The two abutments are founded on four 15ft. diameter wells and two 12ft. diameter wells. Three river piers are founded on 41ft. by 20ft. circular-ended wells, and six piers on two 18ft. diameter wells. The greatest depth of the wells below river bed is 57ft., and a good foundation was obtained on hard shale. The wells, which are of concrete, were sunk, where possible, in the dry, and by grabbing when the water could not be pumped out, additional

concrete being added to the wells as the work of sinking proceeded. No serious difficulties were encountered in the sinking. On completion of the sinking, the bottoms of the wells were sealed by a diver when the water could not be pumped out, and the wells filled up with concrete. The work of building the piers and erecting steel work presented no difficulty, save that the seasons when the river is liable to floods, which are fairly regular, had to be watched.

The quantity of concrete and brickwork in abutments and piers is about 20,000 cubic yards, and the total weight of steel work in the girders is 2776 tons. The design and construction of the piers and abutments of the bridge and the erection of the steel work were carried out by the construction department of the Federated Malay States Railways, and the steel work was supplied by the Metropolitan Carriage, Wagon and Finance Company, Ltd., Old Park Works, Wednesbury, through the Crown Agents for the Colonies.

An All-sliming Plant at a South African Mine.

UNDOUBTEDLY the most interesting mine on the Rand to-day is the West Springs, where, as the result of exhaustive experiments at the Springs Mine—belonging to the same corporation—amalgamation has been dispensed with in favour of direct cyanidation, while the tube mills give a product suitable for direct cyanidation as a slime in an ordinary Butters filter plant; no stamps are required. There are several innovations of lesser importance which strike the expert going over the mine. Starting from the head-gear end of the plant, the stock pile, fed by a 36in. conveyor on a steel cantilever, is a new feature in Rand practice. The usual type of head-gear storage bin in these fields has a capacity of less than 1000 tons, which is more than doubled in the present case. It has been proved that this stock pile, by forming a large buffer between the more or less intermittent supply of ore from the mine and the reduction plant, which is continuously operated, with the exception of Sundays, will greatly assist in maintaining the maximum output. The washing plant is also somewhat unusual. The entering ore is thoroughly washed on a bar grizzly with ¼in. apertures, the washings from which are separated into three products —coarse gravel, sand and slime. The coarse gravel, being thoroughly cleaned from adhering fines, joins the main stream to the tube mill storage bins; the sands, having been leached in dewatering tanks, also join the main stream; and the collected slime is pumped direct to the main slime collectors. The object of this procedure is to obtain the maximum life of conveyor belt. Run-of-mine ore in these fields contains an unusually high percentage of fines, and as a result of the extremely liberal use of water in underground faces, is a most destructive material from the point of view of belt maintenance; in any case, it is necessary to wash the coarse material prior to sorting. The sorting and crushing station is in such close proximity to the milling plant that supervision of the whole process of sorting, crushing, milling and classification is greatly facilitated. As no amalgamation or blanketing process is practised, and as the ore is crushed in cyanide solution, the whole gold recovery plant is compact, and is housed in one building. The tube mills installed at West Springs are about 30 per cent. larger than the standard mill. They are somewhat shorter, but are larger in diameter, the dimensions being 20ft. by 6ft. 6in.

For test purposes a mill of this size was erected and run as an integral part of the Springs Mines plant for some time, with the following results:—Approximately 11,000 tons of ore were milled by this unit, the finished product being collected in a separate collector for measurement purposes. The average output per twenty-four hours over the whole series of tests was 194 tons, and the maximum 208 tons, the output, of course, varying in accordance with the grading of the product. Bearing in mind the average feed, including the crushed returned reject pebbles at West Springs, is likely to be considerably better than at Springs Mines, and the grinding in cyanide is likely to permit of a slightly higher grading of product, with correspondingly increased output of the tube mill, it was concluded that eight of these units would provide ample capacity for the monthly—twenty-six days—output of 40,000 tons required at West Springs. Up to the present all the work has been carried out with tube mill liners of the Osborne bar type. This type has emerged after many years of experience as an effective and economical liner for a tube-mill handling stamp-mill pulp. It remains to be seen whether liners of a radically different type may not come into use for tube mills handling a coarse dry feed.

One or two new types are already in service at neighbouring mines, and apparently give promising results as tonnage producers. Of course, a mere increase of tonnage, regardless of grading, is easily obtained with the older type, but there is no doubt that the new process has opened a wide field for liner experimentation. By far the larger number of mills on the Rand are driven by a single-reduction countershaft, belt driven from the motor. In the Springs Mines and West Springs practice a single-reduction enclosed gear, with forced lubrication, has replaced the belt drive. A considerable economy in power, floor space, and maintenance has resulted from this change.

The original estimate of the capital cost of the West Springs plant was £246,934, and it was closely adhered to. At a capacity of 40,000 tons per month, the cost of the plant is £6 17s. per ton milled per month. The plant having been designed in all respects for ease of extension, any improvement in the daily tonnage of the existing tube mills, up to an additional 10,000 tons per month, could be handled by the remainder of the plant without additional capital cost. It remains to be seen whether the new type of liner referred to will increase the capacity of the plant, and, if so, to what extent. Should the existing eight tube mills some time later reach a capacity of 50,000 tons per month, the capital cost of the plant per ton milled per month would then be a little under £5. When the condition of the mine warrants this increased tonnage, a figure of capital cost will have been attained which is better than that pertaining to the best of the large milling plants built on the Rand prior to the war, with the added advantage of considerably reduced running costs, and, as far as the deep levels of the Far East Rand are concerned, an improved extraction amounting to the difference between 93.25 and 95.50 per cent.

VARIATION OF AERO ENGINE POWER WITH HEIGHT.

IN calculating the performance of an aeroplane from flight tests, it is essential to know the law of variation of engine power with height. In the past it has been usual to assume that the horse-power at various heights is in proportion to the density of the air, but recent experiments, as described in reports and memoranda Nos. 960 and 961, published by the Stationery Office on behalf of the Aeronautical Research Committee, suggest that the law governing the magnitude of the horse-power can be more accurately defined on a pressure basis. Whether this law will be finally accepted will depend upon the result of investigations now in progress at Martlesham in connection with a large number of types of aeroplane and engine. The method used in previous investigations to determine the engine power at a given height involved the assumption that the air screw did not twist under load. To avoid the necessity for this assumption, a torque meter which measured directly the torque of the engine, was designed and fitted to a B.R. 2 engine, and observations of the torque were made at different heights. Other experiments were made to determine the rate of climb, engine revolutions and air consumption on a D.H. 9, with a 200 horse-power Siddeley Puma engine under various conditions of pressure and temperature, with a special air screw designed not to twist under load. In the experiments with a B.R. 2 engine, climbs were carried out at heights up to 17,000ft., and partial climbs at different heights. Measurements of air speed, &c., were taken and the engine torque as calculated was then plotted against pressure and density for different temperature ranges. As plotted, the experimental results suggest that the engine power is very nearly a function of the pressure only, except for low heights, at which it depends to a certain extent on the temperature. A similar conclusion was reached in connection with the Siddeley Puma experiments, with which the engine power was found to be proportional to some power of the pressure—$p^{1.02}$ in this case—rather than to some power of the density.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

CANAL TRANSPORT FACILITIES.

SIR,—The Wolverhampton Chamber of Commerce has expressed a view that the canals by which this important manufacturing district is indifferently served should be converted to roads for the use of motor traffic, but before abandoning a method of transport that in its day competed most favourably with road traffic and which still more than holds its own on the Continent, I write to suggest that if canals be accorded that measure of mechanical assistance which the motor has brought to road traffic, they can still survive usefully.

The question arises at once in what form can such mechanical assistance be supplied, since the problems of canal barges when screw propelled are vastly increased by reason of weed trouble, not to name damage by stranding to screws and stern gear, and the answer so far has been partly supplied by pump propulsion, but I think not completely.

The centrifugal pump or impeller, it is true, can be made largely weed-proof, and though some efficiency is lost, that is a small question if the plant is efficient for its purpose; that is to say, economically efficient.

There is, however, a much neglected prime mover which, coming, like many another invention, before its day, is eminently suitable for this work, and that is the explosion gas pump, generally known as the Humphrey pump. For the past four years I have been experimenting on my own account with a small plant of this family, with the result that I am now assured that it can be most successfully applied to this class of work.

I accept at once the inefficiency of the comparatively high velocity jet it will have to discharge, and will counter by asking, What is the actual efficiency of the usual screw or pump impeller when fitted to heavy full-line craft of the barge type, and where as often as not the action is partly choked by weed, unknown to the operator?

It will be possible to arrange an explosion pump of the type named so that the water intake is visible, and may be cleared by a hand rake from inboard without trouble, or a blow back through the intake valves can be arranged for, so as to clear all *débris* from the rack.

The fuel would be of the cheapest, viz., suction gas. The lubrication question does not arise; damage from neglect is impossible, nor are there any rotating parts to foul obstructions, while the fullest manœuvring powers may be provided for by means of the Kitchen rudder, whose reverse action in this case is not masked by the disc of the rotating screw, and will be therefore more efficient than when used in conjunction therewith.

I claim no novelty for the proposal. The inventor of the Humphrey pump in 1909 advocated his apparatus for marine propulsion generally, and his view was endorsed by a number of well-known scientists. Since then I have had the advantage of inspecting the best-known installation of these pumps, and I confess with a life experience of steamship and steamboat management, I should not advocate its installation for large powers.

But for a barge requiring small horse-power to attain the very moderate speed possible in the narrow waters she has to ply, I firmly believe that a revolutionary application can be made by this means that would greatly benefit Birmingham, Wolverhampton and the Midland manufacturing centres generally.

Being prepared to back my opinion in practical fashion, I am willing to supply the pump for an experimental craft, if any manufacturer or transport boat owner or owners will find the boat, producer and cost of installation. I am also ready to ask their inspection of an experimental plant to illustrate the possibilities first. Naturally, if successful, I should expect recognition, but am quite ready to leave that to the consensus of opinion of the rest, and to deposit cash or security for my share of the contract with THE ENGINEER Office before signing terms.

May 25th. CARPE DIEM.

THE ECONOMICS OF INDUSTRIES.

SIR,—The recent presidential address on "The Economics of the Heavy Iron and Steel Industry," by Sir Frederick Mills, printed in THE ENGINEER for May 8th, sets forth a principle which cannot be too widely known and understood at the present time. Admittedly it is not easy for the layman to appreciate what a large proportion of the purchase price of any staple product is immediately passed on in the form of wages. In the term wages are here included the rewards of all those actively engaged in the industry, from the winning of the raw material upwards.

Our serious writers on economic questions do not usually present the elements of their science in such a way as to be readily understood by the many, but it seems clear that a great deal more could be done in that direction than is ordinarily attempted. The cynics will reply that what is or is not regarded as economic truth is apt to depend solely on the personal opinion of the author presenting it. It is to be feared that there is some truth in the gibe, but at the same time there is a groundwork of facts which are hardly in dispute, but are nevertheless very imperfectly understood.

Sir F. Mills' address is a good example of what can be done in the direction of convincing popular presentation, for he adopted a line of procedure which makes it comparatively easy for anyone to check his results.

It would almost appear to be simpler to determine the percentage of costs not attributable to labour; a casual consideration suggests that they are mainly covered by three items. First, all interest paid on loans or capital; secondly, a portion of the royalty and rent charges; thirdly, a portion of the rates and imperial taxes paid directly by the industry. The investigation must, of course, cover the complete process of manufacture from the ultimate raw materials.

The relatively minute proportion of the total cost which these items account for cannot be too widely known, for once it is known the bottom falls out of the Socialist's contention that labour reaps but a small fraction of the wealth which it produces.

We want a similar analysis for every staple industry. Cannot some of our theoretic economists descend from their pedestals and help in producing something practically useful on these lines? L. H. G. DINES.

Teddington, May 22nd.

NEW SYSTEM OF MAIN LINE ELECTRIFICATION.

SIR,—The article which was published under the above title in Vol. CXXXVIII., December 5th, 1924, pages 630, &c., of THE ENGINEER, is, in our opinion, calculated to create the impression that the system in question is an absolutely new one in the field of electric traction. We would like to say here that the system adopted by the Hungarian State Railways on the trial section of line is practically identical with that known in the United States as the "split-phase" system. As early as 1912–13 the Westinghouse Electric and Manufacturing Company, Pittsburgh, built their 2–4–4–2 double locomotives for the Norfolk and Western Railway with asynchronous phase converters, and these were followed, in 1917 by the 2–6–6–2 locomotive for the Pennsylvania Railway, which already at that date were equipped with synchronous phase converters. Later, in 1922, the new series of 2–4–4–2 double locomotives for the Norfolk and Western Railway and, in 1923, the triple locomotives with the same axle arrangement for the Virginia Railway were ordered from the same company.

The only new and quite novel feature in every respect in the Hungarian locomotive is the very clever design of the phase converter, which originated with K. V. Kando, and the equally clever arrangement for pressure regulation with regard to the needs of the system and the requirements of the motors.

The question of conforming this system—that is, the American split-phase system—to European conditions, its suitability to high frequencies and the possibility of thus linking together the electric railway system and the general power distribution system was certainly treated for the first time in a publication by us under the title "The Phase Converter Locomotive and Its Adaptability to European Conditions,"* a work the first conceptions of which coincide with the beginning of the war. It gives us a certain satisfaction to see that the suggestions which we were able to put forward then have not passed unnoticed.

DR. K. SACHS.
DR. A. C. COUWENHOVEN.

Baden, Switzerland, May 22nd.

* Published in *Elektrotechnik und Maschinenbau* (Vienna), 1919, page 437.

HYDRAULIC BOILER TESTS.

SIR,—In some boiler specifications to which we have to work the importance of getting rid of all air during the water test is, in our opinion, unduly emphasised, and we should be interested to know the true reason for this.

Inspectors have told us from time to time that if air is present during a water test a true record of the pressure is not indicated by the gauge. We cannot think this is so, otherwise the same incorrect indication of the pressure would be recorded by the gauge when the boiler is under steam, and when the conditions are to all intents and purposes analogous. Apart from the presence of air preventing the escape of water to indicate the faulty place, we cannot see why so much stress is laid upon the necessity of getting rid of all air during water test.

We shall be glad to have the opinion of your readers on the subject. BOILERMAKERS.

THE annual meeting of the Institution of Chemical Engineers will this year be held at Leeds on July 17th, and it will be followed by a symposium on "Industrial Water Supply and Stream Pollution," to which papers will be contributed by members of the American Institute of Chemical Engineers who are visiting this country for the purpose of attending this meeting.

THE ONGAR AND BRENTWOOD WIRELESS STATIONS

(*For description see opposite page*)

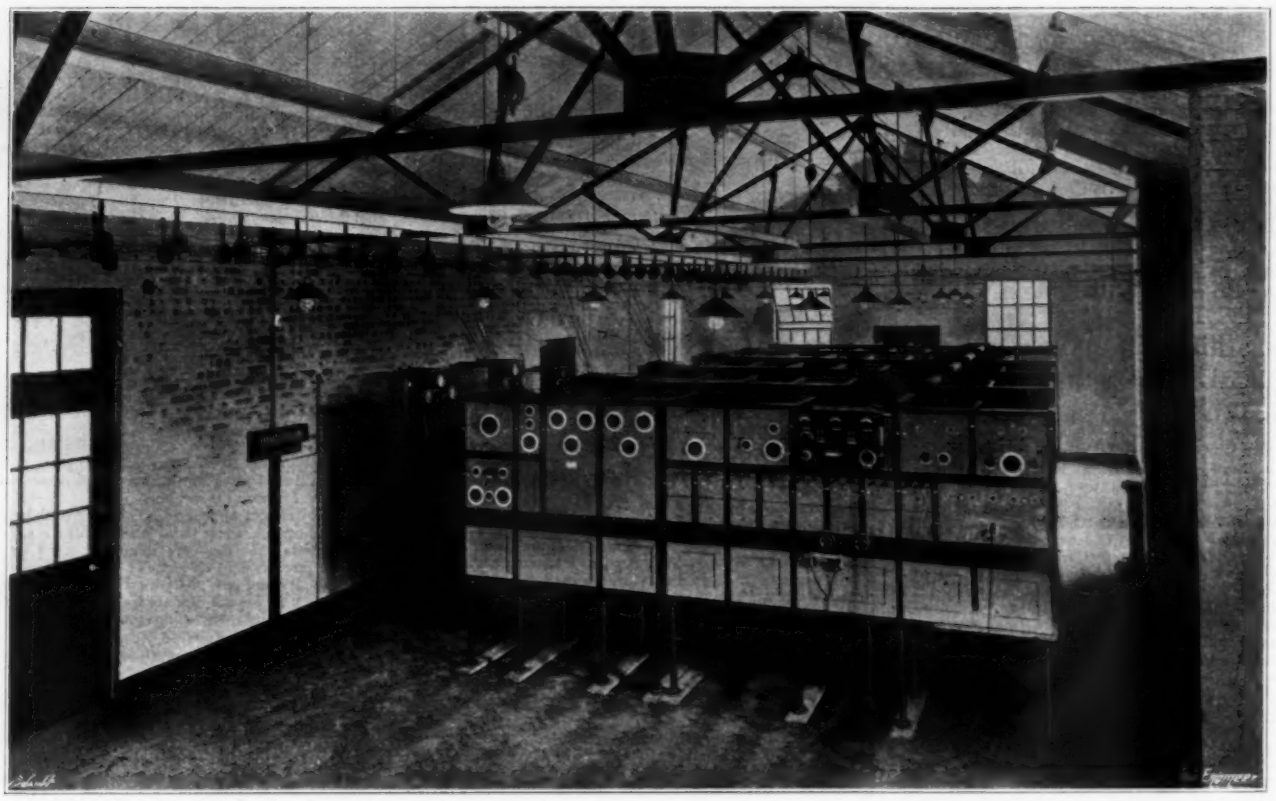


FIG. 1—RECEIVERS AT THE BRENTWOOD STATION

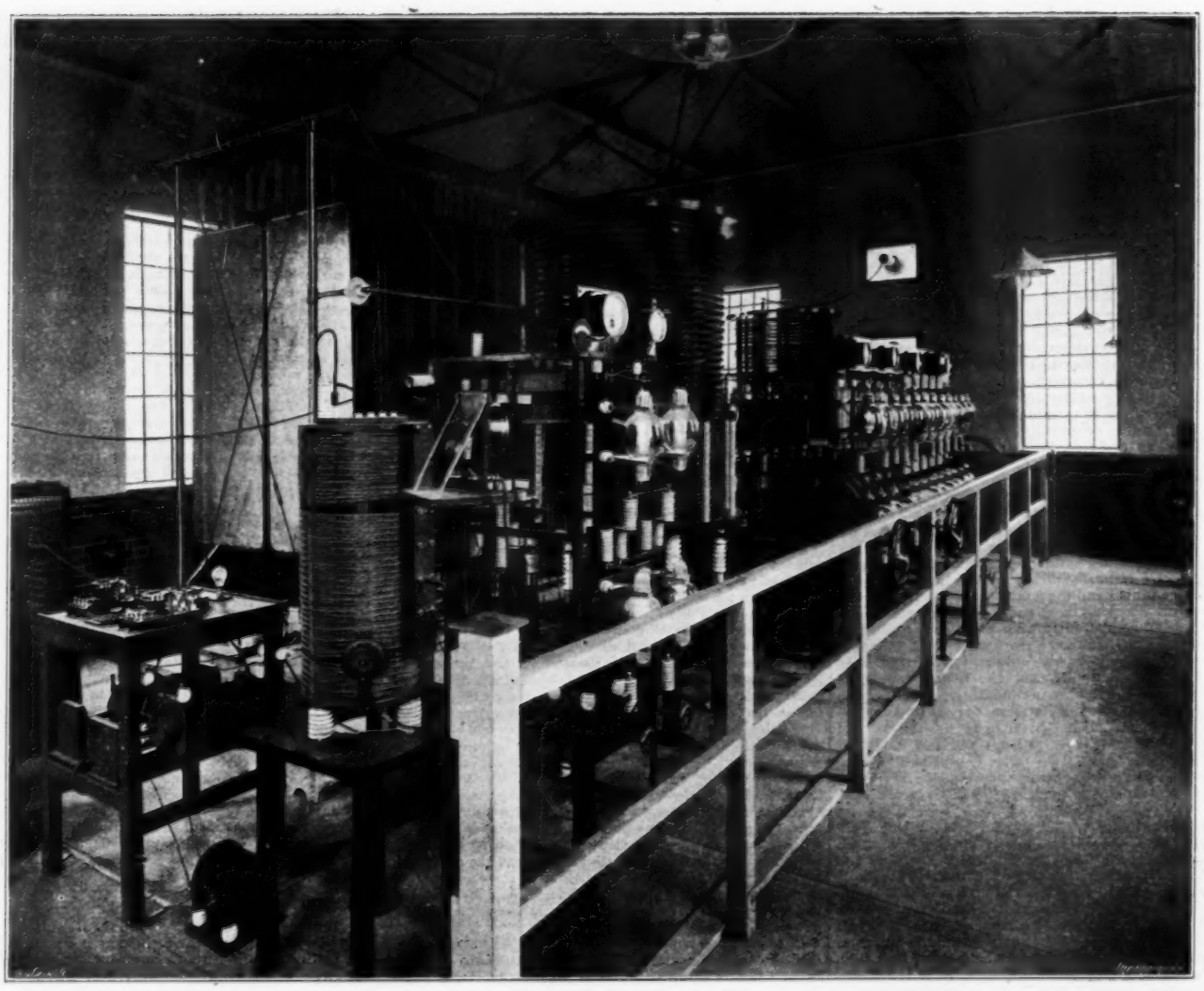


FIG. 2—TRANSMITTER AT THE ONGAR STATION

The Ongar and Brentwood Wireless Stations.

THE Ongar group of wireless transmitting stations, which occupy an area of about one square mile, are situated at North Weald, and serve for communication with Switzerland, Austria and Canada, and, on a single aerial system, messages are also sent simultaneously to France and Spain. The control of the transmitters is centralised at the control office, Radio House, Wilson-street, London, to which incoming messages from the Brentwood receiving station are also relayed by means of land lines. The control office is therefore equipped with the necessary tape perforators and automatic signalling apparatus for operating the wireless transmitters and with the automatic recording and printing apparatus for receiving.

FIG. 3 THE ONGAR POWER PLANT

FIG. 4 THE BRENTWOOD POWER PLANT

Situated as it is in the heart of the business section of the City, the control office naturally becomes the collecting and distributing centre for all outgoing and incoming traffic. No telegraphists are employed at the transmitting stations, the duty of the attendants being merely to adjust and maintain the transmitters in working condition.

All the transmitters at Ongar are of similar design. From a central power station—shown in Fig. 3—power is supplied to the transmitters in the form of 1000 volt 350-cycle current, which is stepped up inside each station to a pressure of about 10,000 volts by means of an ordinary static transformer, full wave rectification being obtained by the use of a bank of two electrode valves, and the current is smoothed out by the usual system of condensers and inductances. High-tension direct current is thus made available for feeding the oscillation generators, which, of course, employ three electrode valves. One of the transmitters at Ongar is shown in Fig. 2, on page 596.

Perfect steadiness of the transmitting wave, which is so essential to high-speed telegraph signalling, is obtained by the utilisation of the Marconi Company's system of independent drive. The fundamental principle of this system, which we have previously described—see THE ENGINEER of March 13th, 1925—is the control of the main oscillations through the medium of a separate standard or master oscillation generator, which once set to the required wave length maintains its adjustment with perfect consistency, for its circuits are not subjected to any variations such as those experienced with an aerial system, as the result of its capacity variations. The oscillating current generated by the drive is introduced into the grid circuits of the main oscillators by adjustable coupling coils. The power of the drive oscillator is, however, small in comparison with that of the main oscillator, and normally it is about 10 per cent. The oscillatory circuit of the magnifier is inductively coupled to the aerial, and as its frequency is controlled by the master oscillator, the transmitted wave length is practically unaffected by alterations in the aerial capacity caused by wind or other natural causes.

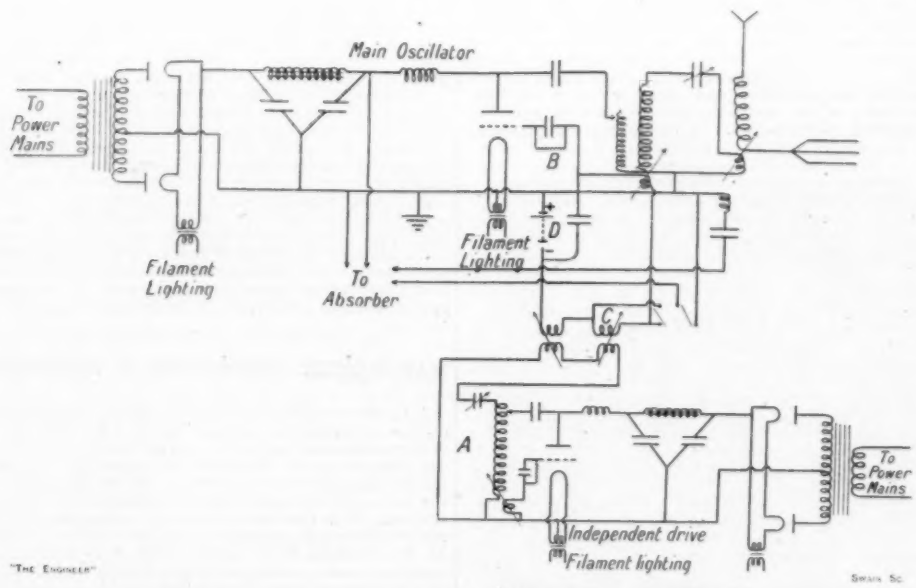


FIG. 5—SIMPLIFIED DIAGRAM OF CONNECTIONS FOR A TRANSMITTER

High-speed signalling is done by means of an electro-magnetically operated signalling key connected across a coupling coil in the magnifier grid circuit. On account of the difficulties encountered in the satisfactory keying a high voltage alternating current at speeds of about 100 words per minute, a special method is adopted. The inductive coupling between the drive oscillatory circuit A in Fig. 5 and the magnifier grid circuit B is obtained by means of two equally coupled but reversely connected coupling coils, so that under the normal condition no voltage is induced from the drive on to the magnifier grids. Across one of these coils C a signalling key is placed, and consequently when this key closes and short-circuits the coil, the other coil acts as an effective coupling and oscillations occur in the magnifier circuit. As the voltage and current across the contacts of the key are comparatively small a short gap and light moving parts can be used, thus allowing of the adoption of a design suitable for high-speed working from a distant control station. A negative bias of about 400 volts, from a source D, is permanently supplied to the grids of the magnifier valves, in order that the current through the valves shall be approximately zero when the key is in the spacing position.

During the spacing periods the voltage across the smoothing condenser would normally rise to the peak value of the transformer, and would seriously strain the insulation of the valves and apparatus generally, and to meet this contingency an automatic power-absorbing device is connected across the smoothing condenser. This absorber is actuated by means of the back contacts of the transmitting key, and the power absorbed is adjusted according to requirements.

An interesting feature of the station working with Paris and Berne is an arrangement which permits two independent transmitters to work simultaneously on a single aerial on wave legths of 2950 and 3850 metres. This is accomplished by so tuning and coupling together the aerial and a closed oscillatory circuit, that the system as a whole oscillates at frequencies corresponding to the two wave lengths required. The two transmitters are coupled to the closed circuit by two coupling coils arranged to balance out in one transmitter the effects of the currents due to the other.

Technical details of each of the transmitting sets are set out in the table given below.

The aerial systems of each station are similar, and consist of a twin cage inverted L aerial, supported on steel lattice towers 300ft. high—as shown in Fig. 6. The aerials are not directly connected to earth, but to an earth screen, consisting of a number of insulated wires supported on 30ft. lattice masts, the screen being arranged parallel to and extending beyond the horizontal portion of the aerial. The interception of the lines of force between the aerial and earth and the provision of metal instead of an earth path for the oscillating current eliminates the losses in the surrounding soil and vegetation which would otherwise occur, and results in an increased radiation efficiency.

Alternating current for the oscillation generators and direct current for operating the signalling key and for lighting is supplied through underground cables from the generating station already mentioned.

In the Ongar station—which is shown in Fig. 3—there are three sets of hot-bulb oil engines, which are coupled to 50-kilowatt 220-volt direct-current generators, which work in conjunction with a "floating" battery of 1600 ampère-hour capacity. The current is supplied to eight motor alternator sets, which provide single-phase 1000-volt current at a periodicity of 350 cycles per second. Constant pressure is maintained on the bus-bars by means of a reversible booster, controlled by an automatic voltage regulator.

Technical Details of the Transmitting Sets.

Station.	Transmits to.	Wave length, m.	Aerial, amps.	Height of towers.	No. of towers.	Anode current, m./amps.	Input anode, volts.
G L A ..	Berne and Barcelona	2,950	40	300	2	500	10,000
G L B ..	Paris	3,850	30			380	
G L O ..	Madrid and Vienna	4,350	90	300	2	1,600	9,500
G L P ..	Canada	5,050	150	300	3	2,800	10,000

Four of the motor alternator sets are rated at 25 kilowatts, and are used to supply power to the valves of the main oscillators, whilst the remaining four machines are each rated at 15 kilowatts, and supply power to the drive oscillators and all the valve filaments. Normally, only three machines of each set of four motor alternators are used at the same time.

At the Brentwood receiving station the reception of wireless traffic from eleven transmitting stations is carried out simultaneously. The receivers shown in Fig. 1, on page 596, are divided into two groups. One group consists of six receivers for the Transatlantic services with the United States of America and Canada, whilst the other consists of five receivers

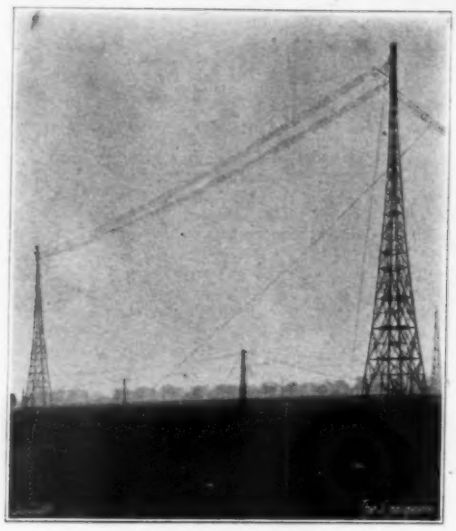


FIG. 6—TRANSMITTING AERIAL

for working the continental services with Paris, Madrid, Barcelona, Berne and Vienna. With the aid of the Marconi-Bellini system of directional reception, six Transatlantic receivers can be tuned to a different transmitting station, and be operated simultaneously from a single aerial system. Underground telegraph and telephone circuits connect Brentwood with the central control office in the City, and there are extensions to the transmitting centre at Ongar. As the received signals are relayed direct to the control office no telegraphists are employed at Brentwood, the duty of the attendants in charge at the receiving station merely being to adjust and maintain the sets so that clear signals of suitable strength are passed

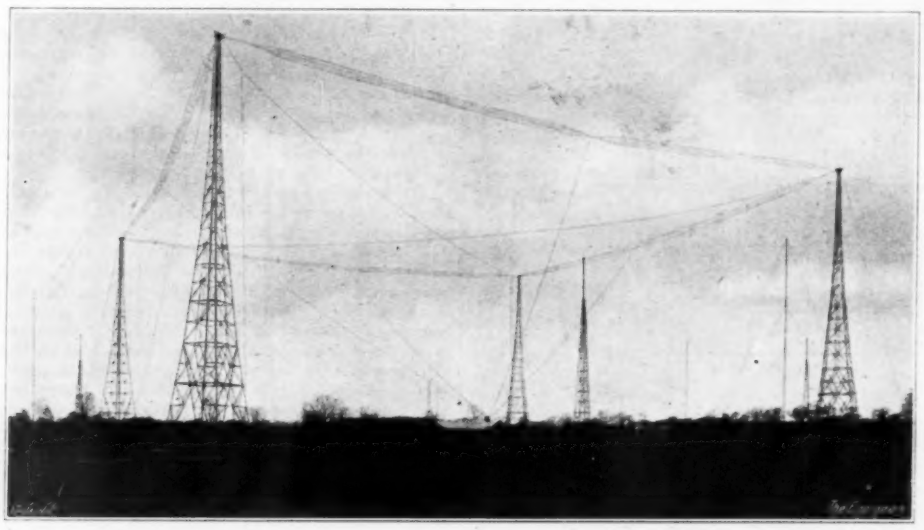


FIG. 7—RECEIVING AERIAL AT BRENTWOOD

on to the land lines for operating the recorders at the control office.

All the receivers at Brentwood are of similar type, and work on the same principle. They are designed on the unit principle, and are mounted in an angle iron rack. Each unit is enclosed in a heavily screened case, thus giving the circuits great electrical stability, and the complete protection afforded renders the use of expensive screened cabins for the separate housing of the receivers unnecessary. Each receiver really performs nine duties, viz., receives signals at radio frequency, selects directionally, filters the high-frequency signals, hetrodynes to a beat frequency of 2500 cycles, rectifies, filters and amplifies the 2500-cycle signals, hetrodynes the 2500-cycle signals to a beat frequency of 1000 cycles, rectifies and selects the 1000-cycle signals, and finally magnifies the 1000-cycle signals which are passed on to the line for recording at the control office.

The receivers are provided with a control panel fitted with resistances for adjusting the filament voltage, a grid negative plug board for giving independent adjustment of the negative voltage applied to the grids of the valves, and various feed milli-ammeters, switches, fuses, &c.

For supplying current to the valve filaments and the anode circuits accumulators are provided, and they are charged by oil engine generator sets—shown in Fig. 4—or, alternatively, from a motor generator set which is fed from a large capacity, which is also used for lighting the station. The aerial systems for the continental services—see Fig. 7—consist of two directional loop aerials, which are supported on a mast 96ft. high, whilst the aerial system for the Transatlantic services is supported on two lattice towers 200ft. high.

Diesel Engine Users' Association.

AT a meeting of the Diesel Engine Users' Association, which was held on Friday, the 22nd inst., a paper was read by Mr. Chas. E. Foster on "The Pyrometry of Exhaust Temperatures of Internal Combustion Engines." This paper, coming as it does after Mr P. H. Smith's recent contribution on the significence of exhaust temperature, was particularly timely, for temperature measurements are of undoubted value in starting up and adjusting engines, and can be profitably continued as a part of the ordinary engine running routine, for if the readings are accurate any impending trouble will be indicated to the engineer in charge long before the actual breakdown stage is reached.

Mr. Foster's paper deals particularly with the design and arrangement of pyrometers, chiefly of the low resistance thermo-electric couple type. After tracing developments in the design of the thermo-couple pyrometer, and its circuit, including the introduction of ballast resistances and compensating connections to make the instrument direct reading, some of the main features of the industrial pyrometers were dealt with. Mr. Foster explained that in the latest type of thermo-electric pyrometer the two elements were made concentric, one forming the outer sheath of the pyrometer itself, while the other was welded into the sheath as a central wire, and was surrounded with insulating material. This design was really a modified form of an older type, but it gave greater accuracy and reduced time lag. In addition, all connections could be made concentric, so that light self-cleaning joints with good insulation and the requisite mechanical strength were easily obtained. The same qualities were desirable in compensating extension and connecting leads, and Mr. Foster deprecated the use of bell wire and thin cable of high resistances. When connecting cable with asbestos insulation and lead sheathing was used there was great danger of trouble, for asbestos when damp might easily act as an electrolyte between the two alloys of the compensating extension and stray voltages of large magnitude, which would destroy the accuracy of the instrument, might be set. In the form of compensating extension recommended by the author, a central rod of special copper and nickel alloy surrounded by insulation, and an outer copper tube were employed. The insulation was held in place and was practically indestructible, so that the copper tube could be bent and run just like an ordinary oil pipe. Connecting pieces, which were splash-proof, were provided for jointing, and the copper tube was earthed to the engine structure. The milli-voltmeter used as an indicator was of the D'Arsonval moving coil type, and for temperatures of the order of, say, 650 deg. Cent or 1200 deg. Fah., a full-scale deflecting torque of about 65 dyne-centimetres was employed for a full-scale deflection. Various methods of coil mounting have been used, and Mr. Foster described the Resilia mounting, in which the moving mechanism is protected from shock and vibration, so that it is impossible for the pivots to strike the bearing jewels.

Various designs of pyrometers with enclosed switches fitted to engine gauge boards were illustrated in the paper. In general, the author recommended that the pyrometer indicator should be fitted on or near the engine with comparatively short leads to give added robustness, and reliability. In concluding his paper, Mr. Foster made brief reference to the resistance thermometer, and pointed out its high time lag and conductor error and the greater complication in the electric circuit caused by the external source of current required. It was true, he said, that the mechanical fragility of the indicating mechanism was about the same in each of the two types, and the resistance thermometer had the advantage of reading to very close limits over a relatively small scale of temperature, which was of doubtful value for exhaust temperature work. The expansion pyrometer in which a ball containing mercury was connected by a fine capillary tube to a Bourdon pressure gauge calibrated in temperature was, he considered, unsafe for use with temperatures above 400 deg. Cent., and even were it used, a separate dial would be required for each point on the exhaust system. He considered that the thermo-couple type of instrument described was the correct type of instrument to use for internal combustion engine work, and he thought it might be said without claiming too much that the instrument-making industry had placed in the hands of engine users and attendants a means of measuring, easily and regularly, temperatures which were known to be vitally connected with the performance and life of the engine.

A discussion followed the reading of Mr. Foster's paper, and some members who had used pyrometers gave the meeting the benefit of their experience. It was generally agreed that although there had been difficulties, particularly with the early types of instrument, the subject was an important one, and further work and experience on the lines indicated would be very useful.

HOW TO CONDUCT AN ANTI-MALARIAL CAMPAIGN.

A CHADWICK public lecture, entitled "How to Conduct an Anti-malarial Campaign," was delivered in the Barnes Hall of the Royal Society of Medicine on Monday, May 25th, by Professor Emile Brumpt, of the Faculty of Medicine, Paris University.

Professor Brumpt explained that the discovery of malarial parasites by Laveran in 1879, the hypothesis concerning their transmission by mosquitoes set forth at the same time by King, Laveran and Manson, and the famous researches of Sir Ronald Ross on transmission of birds' malaria, confirmed by those of Grassi on man's malaria, allowed us nowadays to undertake a scientific struggle against this dangerous plague. In each country the fight had to be differently waged on account of the particular biology of adult and larval forms of the pathogenic anopheles, because of the relations established between man and the mosquito, and according to the degree of the wealth and civilisation of the country. The importance of anopheles in a given region was, he continued, conditioned by the relations established between them and man in the course of ages, and it was owing to the misunderstanding of that main fact that numerous anti-malarial campaigns had proved unsuccessful. Millions had been wasted in suppressing pools swarming with inoffensive anopheles larvæ, while less apparent places where pathogenic mosquitoes were bred, had been neglected.

Professor Brumpt's digest of the whole matter was that to struggle effectively against malaria, a solid entomological instruction must be given to medical men who must determine pathogenic species of anopheles, study their biology and direct the destruction of mosquitoes at different stages of their life history. Then engineers must say what would be the expense of the campaign and the enterprise be undertaken with sufficient material and human labour, an active popular propaganda and strict control. In conclusion, the Professor remarked that anti-malarial prophylaxis study was a splendid example of the services that pure and applied science might render to humanity in increasing its wealth and hastening its social evolution

MANCHESTER ASSOCIATION OF ENGINEERS.

A LARGE number of members of the Manchester Association of Engineers paid a visit to the works of the Carborundum Company, Ltd., in Trafford Park, on Thursday, the 21st inst. The plant is designed and equipped for the manufacture of abrasive goods in all forms from the raw materials, all of which are products of the British Empire. The two most important ingredients, crude carborundum and crude aloxite, are imported from Canada. At the Trafford Park works, covering 13 acres, these ingredients are crushed, purified and graded into various standard sizes of grain and powder suitable for use in the manufacturing operations. After this treatment the materials mentioned are mixed with bonding materials, such as vitreous clays, moulded and baked in kilns, the latest forms of which are heated by gas made in the works by producers. Carborundum and aloxite wheels are also manufactured with silicate, shellac and rubber bonding.

The visitors were permitted to view all the important processes from the pulverising of the raw materials to the final testing of the products, one of the most interesting of these processes being the overspeed testing of the finished wheels and the method of balancing them. After the inspection of the plant, in reply to a vote of thanks proposed to the company for permission to view the works, proposed by the President, Mr. R. Onions, Mr. Martin Hawke, the managing director, made a little speech on the evolution of grinding. He said that twenty-five years ago grinding, except in its crudest form, was little known in this country, and grinding machines costing £300 were considered a big and risky outlay, whereas to-day it was common practice to use grinding machines costing £3000. He said that he had seen a machine recently in a local builder's works which weighed 70 tons and cost £9000, and that, to-day, where there was 1 ton of nature's abrasive product used in the manufacture of grinding wheels, there were 1000 tons of electric furnace products.

These figures are confirmed by the remarkable growth of the Trafford Park works, the kiln capacity of which has grown from 110 tons in 1913 to 500 tons at the present time, while the number of workpeople employed has similarly increased. Altogether, the visit was one of the most instructive which this society has enjoyed.

Railway Matters.

IN order to carry the "King Arthur" class of locomotives, bridge No. 460, that carries the Catford Loop of the South-Eastern section over the main line of the Brighton section, was replaced by a new bridge on Sunday last. It has a span of 120ft.

FROM official records recently kept over a period of one month on the London and North-Eastern Railway, during which no less than 206,023 trains were run, the average lateness was under two minutes. During this period expresses from King's Cross to Aberdeen lost on the average only two minutes, while from King's Cross to Edinburgh the average lateness was less than one minute. From Leeds and York to Glasgow the average lateness was also under the minute.

RESOLUTIONS introduced in the Canadian House of Commons by Hon. George P. Graham, Minister of Railways, on May 1st, provide for the construction of branch lines of the Canadian National Railways as follows:—A line from a point about 5 miles south of Regina, Sask., to Avonlea, Sask., 33 miles in length, at an estimated cost of 941,000 dollars; a line between Turtleford, Sask., and a point in Township 48, a distance of 67 miles, at an estimated cost of 1,871,000 dollars; a line from Sunnibrae to Guysboro, Nova Scotia, partially constructed, to be completed at an estimated cost of 2,500,000 dollars.

THE "Sunny South Special" from Liverpool, Manchester and Birmingham *viâ* Willesden to Brighton and Eastbourne has no longer to be worked with dual fitted stock. The engines on the Brighton section now have the vacuum brake and any vehicle may be used. On Friday last the train was worked from Brighton to Eastbourne by one of the "Gladstone" class engines, which had behind it the very creditable load of 261 tons. It may be observed that whilst no longer does the brake question limit the choice of passenger vehicle, there yet remains the restrictions imposed by the structure gauge due to the smaller diameter of the tunnels on the Brighton section.

IN this column of our issue of February 29th, 1924, mention was made of the desire of the Hull Corporation to come to terms with the London and North-Eastern Railway Company for the abolition of the level crossings in that city. It was shown that the closing of the gates against vehicular traffic caused many hours' delay each day to the Corporation trams, and to the vehicles of private owners. It is now announced that a scheme, which will come before a special meeting of the Corporation to-day, May 29th, has been agreed upon. The cost is estimated at £1,250,000, and two-thirds will be met by the Ministry of Transport; the Hull Corporation will contribute £300,000, and the London and North-Eastern Railway £100,000.

WHEN it was proposed to convert the lines to Guildford to electrical operation, the scheme was one belonging to the London and South-Western Railway, as the Southern had not then come into being. The Guildford line from Raynes Park, *viâ* Leatherhead, to Effingham Junction could be converted, as between Epsom and Leatherhead, because it was jointly owned with the London, Brighton and South Coast and operated by the Epsom and Leatherhead Joint Committee. The grouping of the companies into the Southern Railway has not only removed any difficulties possible from joint ownership, but it has enabled —what is little known—the former Brighton Company's line between Leatherhead and Dorking to be converted to electric traction also. When that is completed in July it will permit of an entirely new public service, viz., trains between Waterloo and Dorking.

THERE are two double junctions at Sutton, Surrey, on the Brighton section of the Southern Railway. On the east the main line from Mitcham Junction joins the line from Croydon—the original Croydon and Epsom Railway—and on the west the main line from Horsham is joined by the Epsom Downs branch. There are four platform lines—two on the Horsham line and two on the branch. The four lines on the east and the four on the west used to become two, but now, so that the more frequent electrical trains to and from Croydon shall not interfere with the main line traffic, the main lines have been slued to the south and the Croydon lines joined directly to the Epsom Downs branch. The electrical trains thus run direct to the branch platform without touching the main lines. Two cross-over junctions are provided so as to give access between the Croydon line and the main line and between the Epsom Downs branch and the main line, so that trains can run between Croydon and Horsham and Epsom Downs and Mitcham Junction respectively. The whole is, generally, considering the space available, an interesting piece of engineering.

THE new third escalator at Liverpool-street on the Central London Railway was put into service on Tuesday, the 19th inst. It supplements the two previously existing escalators which cater for the traffic to and from the London and North-Eastern Railway main line station. The new moving stairway is of "Comb" type, and, being reversible, it will be worked in the downward direction in the morning and upward at night, so as to hasten the exchange between the tube and main-line stations by clearing more rapidly the train loads as they arrive from both those lines. A further improvement has been effected by the provision of additional passage-ways at the foot of the escalators leading to the platforms of the Central London Railway, which should considerably relieve congestion. Since the Liverpool-street extension of the tube was opened in July, 1912, the traffic at that station has steadily grown until it has exceeded that of all other stations on the line. Fourteen million passengers a year are dealt with there, and the traffic is, in fact, 75 per cent. heavier than that at either the Bank or Shepherds Bush. The traffic had, in fact, outgrown the capacity of the original escalator installation, and hence the improvements outlined above. Liverpool-street is the only interchange station where so many escalators are installed, for, in addition to those mentioned, there are also two escalators serving the Broad-street portion of Liverpool-street Station, making a total of five escalators in all, with a combined capacity of 36,000 passengers an hour.

Notes and Memoranda.

THE design of bridge advocated by the London County Council for replacing the existing Lambeth Bridge includes steel arches with a width of 60ft. and a 36ft. carriageway. The cost is put at £680,000.

A STONE, pronounced suitable for sharpening keen-edged tools, and said to be equal in every way to the best imported article, has been discovered near Orbost, Australia. Dressed samples of the stone have been submitted to some Melbourne firms, who say that it would find a ready sale if properly prepared for the market. There is an abundant supply of the stone.

IN evidence given before the Canadian Committee which is investigating Atlantic rates, the log of the corrugated-sided vessel Rio Dorado showed that the vessel, which is 8500 tons deadweight, on a voyage from Hull to Montreal, steamed at an average of 10.5 knots and used 23.04 tons of coal a day. Captain Hocken gave his experience of the costs of operating similar ships, and claimed that the result showed 30 per cent. greater efficiency than straight-sided ships of similar capacity, with greater comparative cargo space and steadier steering.

IN a recent issue of *Vulcan* a warning is given about the use of petrol in starting gas engines. In the case under review the engine would not start with gas, so some petrol was poured into the air inlet silencer. The engine then started readily and began to race. Shutting the gas inlet valve was of no avail, and an accident was only averted by tearing the ignition wire from the plug. It was found that nearly 2 gallons of petrol had been poured into the silencer, and this provided a large supply of fuel uncontrolled by the governor. When petrol is used, it should only be sprayed into the cylinder in definite small quantities.

FORMERLY the lignite industry in Germany removed dust in briquetting plants either mechanically or with water. As most of these plants are in exceedingly dry districts, it was often difficult to provide enough water for the cleaning machines. The electrical cleaning process is now largely employed. In it the dust-laden air is conducted at moderate speed past a number of electrodes of different polarity. The dust particles are electrically charged, repelled, and fall on to a conveyor, and the dust thus collected is briquetted. In a particular lignite drying plant of average size about 0.2 metric ton of dust is recovered per hour, which corresponds to about 8 per cent. of the total factory output. Current at a pressure of from 30,000 to 250,000 volts is required. The power consumption is said to be very low and to amount to only about 0.7 kilowatt for an air volume of 300 cubic metres, or 10,500 cubic feet per minute.

WE are glad to hear, say Messrs. Drabble and Sanderson in their new house journal, the *Sawmill Magazine*, that experiments are being made to lay down sawdust roads. Sawdust is being treated with creosote and other materials and compressed with the object of making the compound capable of standing to-day's hard traffic. There appears to be a good possibility of using chips and dust for road blocks. From tests already made, it appears that sawdust can be used in the proportion of 9 to 1 of Portland cement to make a floor which will stand up to medium traffic. German experiments on the same lines took the form of soaking the wood refuse first in a solution of curd soap and water, then in a thin solution of silicate of soda, these two solutions covering the chips with a coating to which Portland cement would adhere with great tenacity. A fortune awaits the man who can utilise mill refuse in this way and produce a road which can be as readily repaired as asphalt.

THE *Iron Age* points out that in 1919 electric power companies in the United States were using 2.9 lb. of coal per kilowatt-hour; in 1924, through improved power generation, they had reduced the average to 1.9 lb. per kilowatt-hour, based upon average coal consumption of power companies. This meant an annual reduction of 17,000,000 tons of coal. Through the building of larger and more efficient locomotives the railways cut down their coal consumption in 1924 by about 8 per cent., as compared with 1919, saving at least 12,000,000 tons a year. Use of by-product coke oven gas in the place of coal by the iron and steel industry meant an estimated saving in 1924, as compared with 1919, of 15,000,000 tons of coal. These items together account for a saving of 44,000,000 tons a year. There is the additional saving of the coal the railways would use in hauling that tonnage, and that in turn helps to explain why the coal-carrying lines have not run short of rolling stock or motive power, and why railway purchases of such equipment have been falling off this year. When the growing use of fuel oil in place of coal for heating and industrial purposes is also taken into consideration, it is estimated that the development of coal production is at least ten years ahead of the demand.

SOME information is given in the *Electrical Review* relating to experiments resulting in the production of gold from mercury, recently carried out by Professor Nagaoka, of the Institute of Physical and Chemical Research, Tokio. A pressure of millions of volts was employed, which, by a special device, was concentrated upon a narrow space in the immediate neighbourhood of the surface of the mercury. On evaporating the mercury, gold was deposited on the bottom of the vacuum distilling apparatus in a very thin film. The experiment was carried out in an extremely intense electric field. In order to be sure of transmutation, repeated purification of the mercury by distilling in a vacuum at temperatures below 200 deg. was essential. The experiment is to be repeated a few times in order to obtain the best laboratory arrangement, when the method will be made public. The object of the researches is not the production of gold in commercial quantities, but the study of the internal structure of atoms. From an investigation of the fine structure of the lines of the mercury spectrum, Professor Nagaoka came to the conclusion that the nucleus of the mercury atom consisted of a compact central mass with a proton particle elastically connected with it, and that if this proton could be detached from the mercury atom by some sufficiently powerful force the remaining nucleus would have the same positive charge as that of gold and a similar arrangement of electrons.

Miscellanea.

IT is estimated that the cost of a breakwater to protect the beach at Sidmouth would be £60,000.

THERE is some talk of putting up an electric power-house at Plympton, at a cost of some £40,000, but there is considerable local opposition to the scheme.

THE Dusseldorf *Neueste Nachrichten* says it can state on reliable information that the report that Krupps propose to build a factory near Dublin is quite untrue.

IN the course of an inquiry into the pollution of the river Tyne, it was stated that the cost of a comprehensive scheme to reduce the pollution had been estimated, ten years ago, to be £2,000,000.

THE New London Lead Company, Ltd., it is announced, has been formed for the purpose of working the lead mines of Upper Teesdale, which the old London Lead Company relinquished in 1902, after having worked them since 1688.

IT is reported that Herr Flettner proposes to construct another rotor ship, of 3000 tons, and with only one tower, but of greater power and stability than the Buckau. The German authorities have issued regulations for the navigation of rotor ships.

THE Foochow Electric Company, China, proposes to construct a hydro-electric power plant of 5000 kilowatts capacity on the upper reaches of the Min River. The cost is estimated at about £200,000. It is said that the river could be made to furnish 50,000 kilowatts.

WORK will be started immediately by the Western Electric Company on four new rapid-transmission trans-oceanic cables. The first will connect New York with Bayroberts, the second Bayroberts with London, the third Victoria (B.C.) with Suva (Fiji), and the fourth will run from Emden to the Azores, where it will connect with the Italo-American cable.

IT is proposed that the new British Embassy at Tokyo, which is to replace that damaged by the earthquake of 1923, should be built of monolithic reinforced concrete. The foundations are to consist of a reinforced concrete raft on piles, and the roofs will probably be flat. The buildings will be only two storeys high, and not longer than 110ft. The cost is estimated at £300,000.

THE Acting British Consul at Kovno, Mr. G. W. Berry, reports that the Supply Service Department of the Railway Administration is inviting tenders, to be presented by June 11th, 1925, for the supply of various spare parts for locomotives. United Kingdom firms in a position to supply British materials can obtain further particulars regarding this call for tenders on application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1, quoting reference A X 205.

WITH a view to the improvement of the engineering curriculum of McGill University, Montreal, and bringing it into more effective relationship with modern conditions in engineering practice, the Faculty of Applied Science has sent out questionnaires to 1800 engineering graduates of the University. The recipients are asked for their opinions as to the value of the training received in McGill in the light of their professional experience, and the subjects of the course which they have found most useful in their practice and those which have been utilised the least. The Faculty is co-operating in this investigation with the Society for the Promotion of Engineering Education.

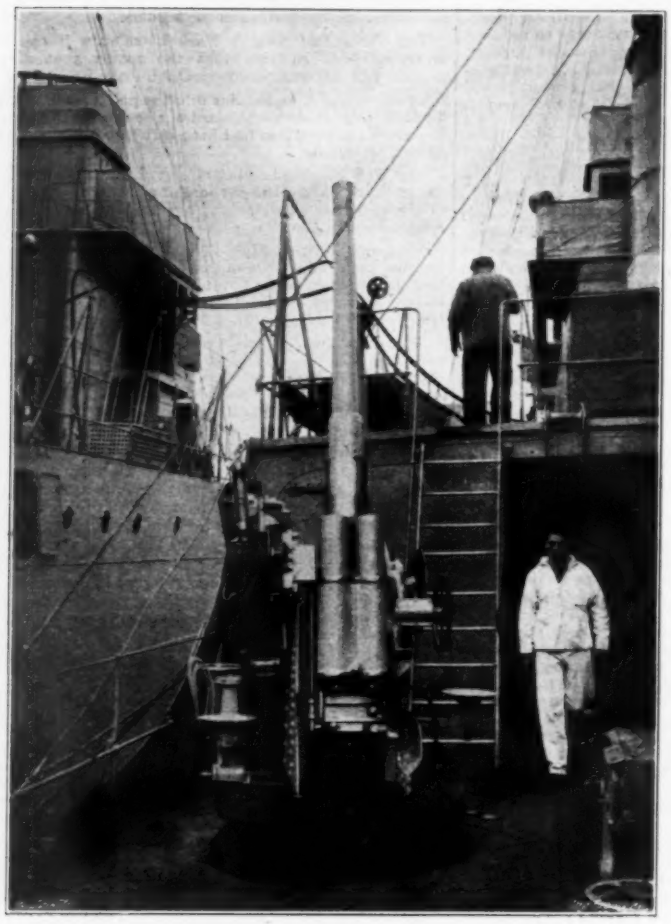
THE initiation ceremony in connection with the Batley Corporation's new reservoir took place on May 18th, at Holmbridge, near Huddersfield, in the presence of the Mayor of Batley and a numerous gathering. The works will, with the pipe line to Batley, involve an expenditure of £500,000, and will take five years to carry out. When completed, the new reservoir will hold 300 million gallons of water. Extensive boring and grouting operations are being carried out, to ensure water-tightness of the strata below the dam. The ceremony was carried out by Councillor J. E. Oldroyd, the chairman of the Waterworks Committee, who, by pressing a silver-mounted button, fired the first charge in the main trench.

DURING the last few months the development of the wireless industry in Russia has made great strides, and a wide interest has been created, not only in the towns, but also in the villages. As an outcome of that interest, a Wireless exhibition is being organised in Moscow, which it is proposed to continue until the end of August. One section of the Exhibition will be specially devoted to foreign manufactures. Any foreign exhibit may be sold, subject to the regulations relating to foreign trade, and all such exhibits will be considered on their merits in the adjudication for prizes. The Exhibition will be held in the Polytechnic Museum, Moscow, and the nine sections will deal with every phase of the history and development of the industry.

THE Han Yeh Ping Coal and Iron Company, the largest ironworks in China, has contracted for another loan from the Yokohama Specie Bank, amounting to Yen 8,500,000. Japanese interests have now advanced about Yen 45,000,000 to the company since 1913, or two and one-half times its paid-up capital, which is 18,000,000 dollars. The company has been exceedingly harassed in the last few months by the results of the military operations in China, which for some time stopped its coal supply. One furnace at Hanyang and one at Tayeh had to be closed down. Only 200 tons of pig iron daily are being turned out at Tayeh and none at Hanyang, although the normal output of the latter was formerly 400 tons per day. This is the reason why the company had again to turn to its Japanese creditors. The proceeds of the loan, which is in the nature of an extension of the original agreement of 1913, under the terms of which it represents an advance payment for iron to be delivered to Japanese interests, are to be applied to the purchase of new plant and machinery. This will enable the company to produce 400,000 tons of iron annually. The new loan will also enable the company to reorganise its administration and to expand its selling organisation in China and foreign countries. In accordance with the original loan agreement of 1913, the new conditions give privileges to the Japanese lenders in purchasing products of the company at prices mutually agreed upon.

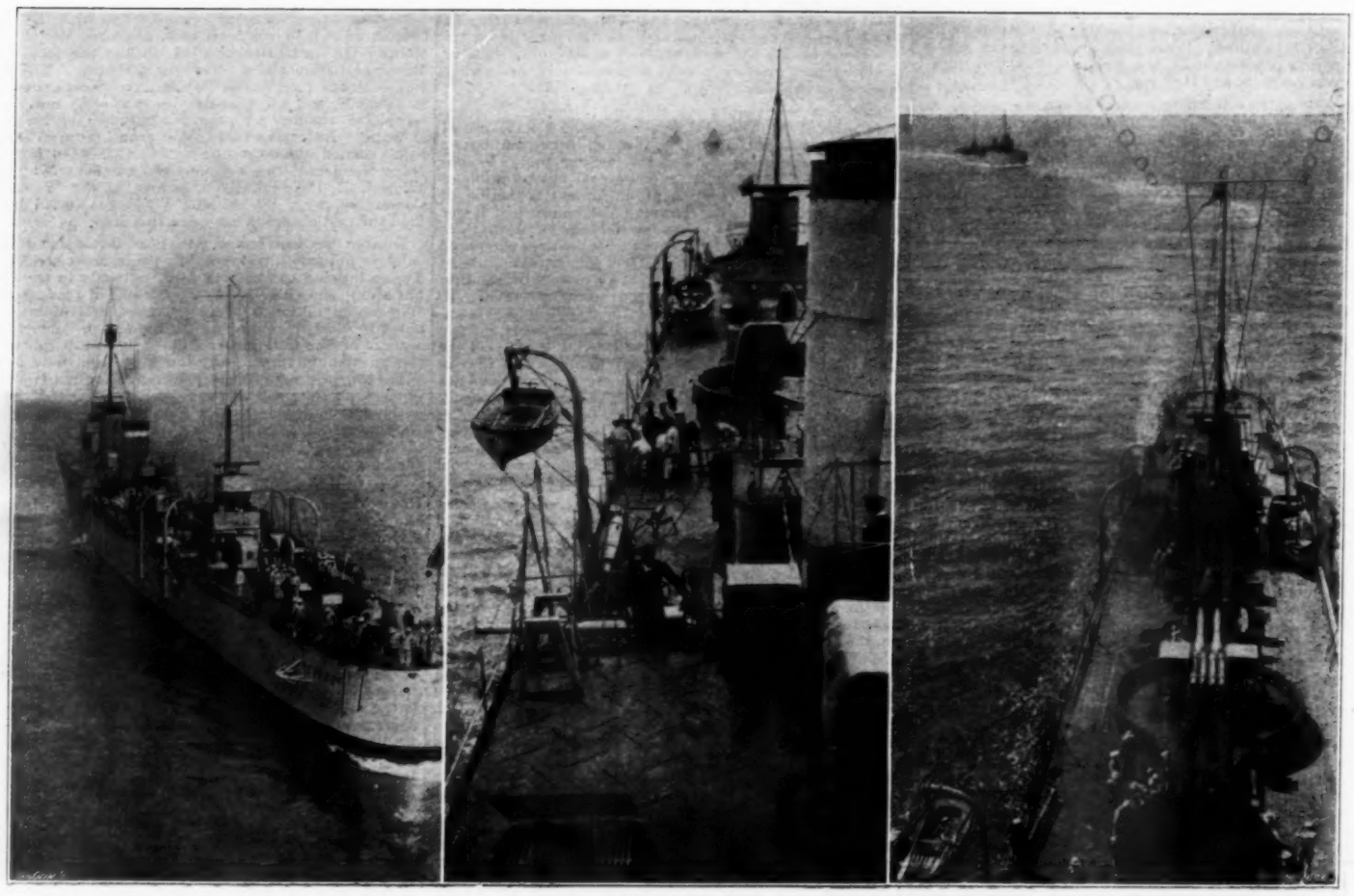
THE ITALIAN SCOUTS LEONE, TIGRE AND PANTERA

(*For description see page 604*)



ANTI-AIRCRAFT GUN ON THE LEONE

TWIN 4·7in. GUNS ON THE PANTERA



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SIXTEEN PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist

THE MAY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

MAY 29, 1925.

Unemployment Percentages.

MONTH follows month, and for three years the monthly statistics of the rate of unemployment amongst insured persons has with monotonous and depressing irregularity remained at a seriously high figure. Taking the United Kingdom of Great Britain and Northern Ireland as a whole, the average number of unemployed persons since July, 1923, has been well over a million. This figure covers practically all wage earners other than agricultural labourers and domestic servants. Obviously it is too high to be accepted complacently as normal, but it is of interest to consider what we may regard as an average rate marking the border line between the alternative of prosperity and the depression in industry? Empirical figures may be arrived at in various ways. After all, everything is a matter of degree. The April figures give a national total of 11.2 per cent. of insured persons—1,292,131 individuals—as unemployed. This total embraces coal mining with 11.6 per cent., out of 1,260,350 individuals unemployed; the combined textile industries with 1,312,750 persons, with 11.5 per cent. unemployed; and the combined metal, engineering and shipbuilding trades with 20.2 per cent. unemployed, out of 1,589,890 insured persons, to say nothing of other groups of industries. While there are variations between group and group in the group-percentage, there are greater divergences among the industries comprised in each main group. Thus in the individual textile trades there are such figures as 7.1 per cent. in the cotton trade and 35 per cent. in the linen trade, with woollen and worsted at 16.5 per cent. Of the engineering trades, electrical engineering has only 5.6 per cent. unemployed, but shipbuilding has 31.4 per cent. and tin-plate making no less than 36.8 per cent. Of those employed in making pig iron 20.8 per cent., and in steel and iron furnaces, rolling mills and forges 26.7 per cent. are unemployed.

With such diversities it is difficult to say what figures may be accepted as normal for either the country as a whole or any particular group of industries. Although there is considerable interaction and re-action between different industries, it is in the very nature of things that synchronous movements of exactly proportioned extent cannot take place. Hence the national percentage figure—important though it is in determining whether the unemployment insurance fund is increasing or decreasing its indebtedness to the Treasury—does not give us such valuable indications as are afforded by group figures? How then can we arrive at empirical figures for the different groups? Obviously the basis must be that of the cumulative experience of a sufficiently long period. The period covered by the unemployment insurance scheme now operating is too short for actuarial purposes. On the other hand, in extended periods we have changes in statistical method so that comparisons are likely to be relative rather than precise. Some changes in method do not impair very greatly the continuity of the record. In the fiscal controversy of nearly two decades ago the Board of Trade compiled and issued two volumes entitled "British and Foreign Trade and Industrial Conditions." The second of these volumes, published in 1904—its reference number is Cd 2337—deals *inter-alia* with the course of employment in the United Kingdom over a number of years. While this book and its successor—No. Cd 4954—published in 1909 give figures relating to certain trades as far back as 1854, there is no need to seek information earlier than 1870. In the case of engineering, shipbuilding and metal trades up to 1908, a change in the method of classification was made in 1888. Prior to that year the estimates as to the percentage of unemployment were based solely on the returns of the numbers unemployed at the end of each month, but thereafter they were partly computed from expenditure on unemployed benefit by the unions concerned. For each of the five years ending in 1892 computations are available based on each method. The average figures are 4.54 per cent. and 4.46 per cent. The difference, it will be seen, is almost negligible. Hence, from a study of the figures and despite the change of method, we deduce that from 1870 to 1908 the average unemployment in the engineering, shipbuilding and metal trades, as a whole, was about 6.57 per cent. Save to mention the four very bad years ending in 1887, when unemployment averaged 11.9 per cent., followed immediately by four years with an average rate of 3.6 per cent., there is no need to go into the details of individual years of the period, which is a sufficiently lengthy one to give us an empirical figure of 6.6 per cent. as representing the average rate of unemployment in these trades. The group is a specially vulnerable one—apart from its own internal questions, and apart from the stress of foreign competition it is specially susceptible to fuel prices, and takes longer to get into its stride again than many other industries after a strike in the coal mines. Certainly no British industry is feeling the strain of high coal prices so acutely as the iron and steel trade.

Hence we arrive at the interesting conclusion that we may regard a margin of plus or minus 1 per cent. above or below 6.5 per cent. as covering the range of unemployment in the metal, engineering and shipbuilding trades corresponding to a period of indifferent trade. At 7.5 or over, the description "bad" would apply, and 5.5 per cent. to 4.5 per cent. or under, the description of fair to good. At 2.5 per cent. or under, the conditions are those of a boom period, and any figure over 12.5 per cent. is characteristic of acute depression. Unfortunately, the blue books to which reference have been made do not enable us to ascertain a similar set of empirical figures for the textile or transport trades. Inquiries by the Ministry of Labour in the Manchester, Bradford, Dundee and kindred areas, together with the returns of the Registrar-General of Friendly Societies, could provide them. Alternatively the industries involved could secure them—possibly the average would be 5.5 per cent. and not 6.5 per cent. Our concern is with the engineering industries in which, when measured by our empirical figure, the April figures issued by the Ministry of Labour show only one section, viz., that of electrical engineering, to be satisfactory.

Apprenticeship.

IT appears from a paper which was presented at the Spring Meeting of the American Society of Mechanical Engineers that America is disturbed by the almost complete disappearance of the apprenticeship system. The author, Mr. Falk, of the Falk Corporation, Milwaukee, told his audience that "this American workshop of ours is made up of an almost infinite number of professional, commercial, and industrial jobs. Until a few years ago we filled a considerable portion of the skilled jobs with Europeans, trained for the work. But now we are faced with the necessity of filling these same ranks with American-trained youths. This has made it necessary that we again consider the efficacy of the old method, and perhaps the only

method, of training on the job, apprenticeship." He then reviewed, quite shortly, the systems of our fathers when the "Old Man" looked after his 'prentices and took a pride in their progress; and after contrasting that training with the lack of training which is the inevitable result of modern methods of production, he concluded that "there is not an industrial community in America to-day that is self-supporting or solvent in its *personnel* phase. And the vitality of our industrial life must be judged by the solvency, in this respect, of our individual communities, and not by a few individual plants." He added that "there has grown a rather universal disregard for true vocational training and education. All strata of society are more or less involved in the abandonment of this idea. Our formal educational system has come to ignore it quite completely. Scarcely anywhere is vocational training, industrial education or apprenticeship a vital concern in the lives of the American people."

We have not yet the reports of the discussion upon this paper, but we shall not be surprised to find in them, when they come to hand, a good deal of dissentients from the view of the author. On the one side, we may expect protests from those who believe that apprenticeship is an antiquated and effete system as unfitted for, as it is impossible in, modern industry; whilst, on the other, we shall meet those who deny that vocational training is dying out, and who point to the technical institutes and to the educational system which are provided by some of the greater works. It is, indeed, possible that Mr. Falk did exaggerate a little bit. He appeared as a propagandist for a National System of Apprenticeship, and propagandists invariably stretch their arguments to the limit, but we have no doubt that in substance he was perfectly right. The same movement is occurring here; apprenticeship in the true meaning of the word is disappearing from a great many of our industries, and its place is being taken by a kind of pseudo-apprenticeship which lacks many of the virtues of the departing system. Take it for all in all, apprenticeship bred as fine engineers, both civil and mechanical, as the world is likely to see. It had its defects, it had its black sheep; but, on the whole, the results were very satisfactory. From an early age, too early even in recent years to accord with modern views, the young engineer was started upon a vocational course of education of a very practical kind. He did not find himself at the age of one and twenty—as he may to-day—equipped—bless the mark!—to open his career in a dozen different directions, and uncertain which to take. When he came of age he was out of his time, and a full graduate of the trade or profession to which he had been indentured. He had had to rough it; he had had to scramble for knowledge; he had had to pick up his own experience by failure; he had had to depend upon his own powers of observation and exercise his own tact in extracting secrets of his craft from their owners. It was a hardish life, but it winnowed out the good from the bad, the men of character from those without, the men of aptitude from those lacking it. Who knows how much America herself owes to the mechanics who were trained by the roughest methods in the "two-man" shops and forges of her little knots of settlers? It was in such places that the mechanical instinct was nurtured. Westinghouse was the product of such a shop, and we know not how many more of the men who have made the American mechanical engineer famous the world over for his ingenuity. In this country one might with more ease number a score of great engineers who had been made by the old method than a dozen who had been made by the new. But the conditions of those days have gone, and it is fruitless to lament them. Rather must we, too, consider as our cousins are doing if we can save something of the merits of the old system and combine it with the new. Fortunately, being conservative by instinct, we still hold to apprenticeship in some measure, and some of our great works have apprenticeship schemes conducted on modernised lines.

The greatest of all the virtues of the old, rough method was its qualities as character builder. No other system yet discovered is so good in that respect. That is their weakness. Only the A 1 men won through the hard fight of our forebears. We have made things so easy that the man of C 3 character and physique is not infrequently able to block the path of the better-fitted man, although through his own disabilities he cannot himself reach the summit. We still pay far more attention to success in examinations than to those things which really count in the battle of life. It is our proud democratic boast that we give all an equal chance, that we have set up "a ladder from the board school to the university and the promised land beyond." But the ladder tends to become an escalator on to which the candidate need do no more than step to be carried to the top. It has not yet been proved that we are doing the best for our industries by this method. In the old system men had to fight for and seize their opportunities, now they are presented with them. We gain something, no doubt, by this method. There is greater equality and greater volume of knowledge. That is something; but, on the other hand, there is less outstanding capacity. There are more able men in engineering, far more, than there ever were; but there are fewer great men. Is that the result of the new system of training and education, or the inevitable result of the changed conditions of industries?

Obituary.

WILLIAM CLARK.

THE death is announced of Mr. William Clark, of Eaglescliffe, on the 20th inst., after a long illness.

Mr. Clark was the senior official on the staff of Head, Wrightson and Co., Ltd., of Teesdale Ironworks, Thornaby-on-Tees, he having entered the services of that company in 1867. He was very highly esteemed by his employers, and his knowledge and experience was invaluable. As engineer-in-charge of all outdoor erection contracts, Mr. Clark had been most successful in carrying out various large and important works in different parts of the world, amongst them being:—The Thames Bridges at Putney and Barnes; Grosvenor Bridge; Victoria Station; Waterloo Station; Tavy Bridge; Laira Bridge, Plymouth; Walnut Tree Viaduct, Rhymney; Pwll-y-Pant Viaduct; Weston Mill Viaduct; Dover Harbour Pier, and many others.

During the last two or three years Mr. Clark had gradually retired from more active work and acted in a consultative capacity to the company. His death will be mourned by a very large circle of friends, as his long life of service brought him into close touch with all the principal railway and harbour engineers in the country.

ARTHUR HUGH BALDWIN.

AFTER a long and painful illness, Mr. Arthur Hugh Baldwin, chairman of Kendall and Gent, Ltd., machine toolmakers, Manchester, died on the 24th inst., in his seventy-first year. Mr. Baldwin had been associated with the firm for a very long time and had much to do with the success which it achieved in the manufacture of machine tools. He was also a director of the Associated British Machine Tool Manufacturers and was formerly on the board of the Manchester and District Engineering Employers' Federation. Although Mr. Baldwin did not take any active part in public affairs and was rarely to be seen at meetings of technical societies, he was a man with very sound ideas on machine tool design, and his advice was always worth having on business affairs. But perhaps his chief characteristics were his genial disposition and kindliness of manner. His death will be greatly regretted by a very large circle of friends. Mr. Baldwin was a member of the Institution of Mechanical Engineers, the Manchester Association of Engineers, and a founder member of the Engineers' Club, Manchester.

Literature.

Screw Propellers. By Admiral C. W. DYSON, U.S.N. Third Edition. London: Simmons-Boardman Publishing Company. 1925. Price £3 7s. 6d.

IF one were asked the question, "On what kind of data should a book on screw propellers be based?" the answer would be, "On full scale results if you can obtain data reliable, and in sufficient quantity." Up to the present, however, that has not been possible, and model data have been used. Admiral Dyson has refused to accept this restriction, and this third edition of his work is based entirely on full scale results. In reading the book this fact is very noticeable and sometimes rather startling. Model data are used only for effective horse-power when necessary, but wake, hull efficiency and propulsive efficiency from models are not used as such, although, of course, something to take the place of the two former has been devised. In fact, one obtains the impression that the author has avoided theory as much as possible and used model data for ship figures only under compulsion, when they could not possibly be obtained from ship results. He takes his results as he finds them on the ship, and by charting for various characteristics, produces the data which form the basis of his system. This avoidance of basic theory probably explains the absence of any mention of Froude's actuator or "momentum" theory in the very brief summary of the theoretical treatment—the only theory which has stood the test of time. Also, R. E. Froude's method of separating the hull and propeller into distinct sections, although forming the basis of all the methods given, is not mentioned directly.

Anyone using the book is advised first to read the preface—a very human statement—before adventuring upon the uphill work of handling roughly one hundred different symbols, with the knowledge that the author is a fellow-man who knows his liability to error. Our knowledge has advanced considerably in the twelve years since Admiral Dyson's first edition was published, and we cannot but admire the man who can discard much of his previous work and replace it by data based on other general lines, "retaining only the well authenticated points"; for this third edition is practically a new book.

The elaborate subdivision of characteristics of hull and propeller, which is a necessary part of Dyson's work, and the rather formidable charts in the atlas, suggest at first unnecessary complication of data. It is as well to know, as we are told in the preface, that these data have been through a stringent refining process, have been on their trial in Admiral Dyson's office, and been found reasonably accurate. No one attains success in the technical world without considerable labour, and no one can deny the immense amount of labour involved in the production of a volume such as this.

The author has accepted the complicated character of his subject and charted all his main variants. The reader has to grasp the nomenclature and must put his faith in the author, as it is not feasible to check the charts and constants except by using them, and by comparing results produced from the chart with one's own ship data.

Taken broadly, the author's methods are on recognised lines; the hull and propellers are treated as related things, each of which can be reduced to type apart from the other. But his methods are exceptional in his mode of reduction and the way in which he correlates the two. The basic equations used in the reductions are of the usual accepted type. First, as regards the hulls, they are divided into three main types, and charts are given for separating type and for correcting the block coefficient to a standard coefficient so as to take account of the ratios breadth to draught, breadth to L.W.L. length, midship section, and other characteristics of the hull. These standard coefficients vary according to the type of propulsion adopted, single, twin, &c., and the corrections vary with type of hull. These "S.B.C." or slip block-co-efficients, together with the proportions of the after body, are the determining factors in settling the basic slip to be used, according to chart, with the given propeller. In a similar way a "K," or power loss due to hull coefficient is determined, the K in this case being corrected by another chart for tip clearance from hull.

Admiral Dyson's screw propeller data are represented by six charts, but unless cavitation is suspected, one need only work with three, the slip, basic and corrective charts. These basic data are given for three-bladed screws of more or less elliptical blade outline, with circular backs to the cross sections. The most striking feature of them is their presentation on a base of projected ÷ developed area of screw blade, this ratio being used for the curves of propulsive coefficient, indicated thrust per unit area and tip speed of propellers. How far this rule can be accepted can only be tested in individual cases. For low pitch ratios one can support it somewhat from general reasoning, but departures might be expected at high-pitch ratios, and the author's law of efficiency is open to doubt on this score. These basic curves represent the best that can be done, and the best relation of the different factors to be associated with the basic slip (apparent) determined from hull considerations. These basic data for any given speed involve the development of given power at any defined slip, and the designer is here permitted to choose what his load factor shall be in comparison with this power. To assist him, there is a chart showing the ratio of the required speed to basic speed, on a base of developed power ÷ basic power, at which, for given basic slips, cavitation will commence. The designer should keep well clear of these conditions if he can, and may choose any number of points and obtain a series of propellers if he wishes.

A word of warning is required in using these basic data, as they do not always vary with dimensions as one might expect. For example, the basic E.H.P. varies as dimension squared and not as (dimension)$^{7/2}$ as do comparable powers at "corresponding" speeds in a ship. Basic slips and relative basic revolutions are also different with different sized ships.

Cavitation is given some eighty pages altogether. One noticeable feature of the author's is treatment of the entry into cavitation. This is determined solely by the relative ratios of actual speed and actual power to the "basic speed and power respectively." At first sight this is peculiar, but inasmuch as these basic data depend upon mean pressure per unit area, the peculiarity is more apparent than real. The author includes in his treatment of cavitation some cases which one might regard as only very loosely connected with that phenomenon, but this is only a matter of definition, as his object is to detect and evade the trouble, call it what we may.

The section on strength represents general practice.

and is largely based on the Bureau of Engineering formulæ and methods. It is noticeable, however, that the method of determining the length of the effective arm of the thrust for obtaining bending moment is not discussed, this length being accepted as a fixed fraction of the diameter.

The newer problems which have arisen in recent years with screw propellers are all dealt with. The air propeller is treated on similar lines to the hydraulic, and a similar chart of basic data is given for it. This chart is necessarily drawn for propellers of constant pitch, but the subject of variable pitch at different radii (a common practice in aeronautics, although not much used in ships) is left untouched.

A fair amount of data on stopping and backing big ships, especially when electrically driven, are given, the data being based on trials carried out on the Jupiter, and supported by trials in the U.S. testing tank. Another problem also arising with electrical propulsion is that involved when turning the ship, whilst the engines endeavour to maintain constant revolutions on both the inner and outer screws relative to the centre of the turning circle. With steam propulsion the revolutions on the inner shaft fall away, and on the outer increase, and so assist in turning the ship. The effect of this departure is given in figures and appears to be less imposing than one might expect.

Whatever may be said of the mode of correlating data and presenting them, the author has strengthened his case enormously by the large number and varied character of the examples worked out. Over eighty problems and cases are dealt with, most of them in full detail, and one has to admit that comparison of ship result and estimate by the Dyson method is remarkably good in most of these cases. There are some things in this method of estimating which are still left to the judgment of the designer, such as the difficulty of settling the value of the power loss coefficient, and load factor, but even in these the author's guidance is fairly clear. The only test of such a book is to try it out in a number of cases. It should prove particularly valuable to those dealing with large high-speed ships, and with submarines, as the data *re* such vessels are exceptionally good. Whoever uses it should first check the constants used against a ship already running, as the coefficients employed are based on American tank practice. The Tideman friction coefficients which are used differ a little from the English data, and here block coefficients are more usually worked out on length B.P. than on L.W.L., as in the book.

The Preservation of St. Paul's Cathedral and Other Famous Buildings. By WILLIAM HARVEY. London: The Architectural Press, 9, Queen Anne's-gate, S.W. 1. Price 10s. 6d. net.

OUR readers are already familiar with Mr. William Harvey's work by reason of the interesting articles which he has contributed to our pages on the preservation of Westminster Hall roof and of St. Paul's Cathedral. The study of ancient buildings and the manner in which they decay is a pursuit of many-sided interest, and of some adventure. Mr. Harvey has undoubtedly a gift for it, and in prosecuting it has acquired a large and sympathetic experience of the subject.

The view held by Mr. Harvey that the preservation of ancient structures demands a special study, that it is neither wholly an architectural matter nor wholly one of engineering, but a complex compound of both, can hardly be disputed. Pure engineering applied, for instance, to Westminster Hall roof, would probably have left the structure in a thoroughly sound state, but at the expense of much unsightly steel work. Pure architecture would more likely than not have failed to appreciate the full significance of the exact manner in which the roof is built, and, as has actually happened in the past, might easily have applied restorative measures at variance with the original plan of the structure. Mr. Harvey argues that a decaying building is of necessity a moving building, that the ordinary formulæ of the structural arts apply to static conditions, and that they cannot or should not be applied to structures in process of decay. In other words, the preservation of an ancient building is a problem in kinetics rather than one in statics.

Of St. Paul's, its decay and how, in Mr. Harvey's view, its preservation might best be secured, our readers, as we have said, already know something. In this book, neither too technical nor too popular, they will find a considerable amount of fresh and highly interesting information. Of some of the attempts made in past years to repair the fabric we read with amazement. These repairs in the case of the eight main central piers have consisted of patching and replacing the facing stones, which alone are really effective in supporting the load, the interiors being filled with lime mortar rubble. In some cases, Mr. Harvey tells us, the new facing stones have been attached to the old work by merely hanging them on with metal cramps. In others, new stone faces have simply been applied over the old, so as to hide the cracks in a neat manner. In yet others, the patches have actually been tied on with wisps of tow and old iron pegs. These things were done in the past, but even the methods employed to-day are regarded by Mr. Harvey as little more than patching. The marvel is, he writes, that the patchings carried out with Chinese diligence during the last two centuries have not already achieved the destruction they have undoubtedly hastened; there will come a time, however, when one such patching scheme will be the last that the weary building will endure.

In an enlightening diagram, Mr. Harvey contrasts the central mass of St. Paul's Cathedral with the dome of St. Peter's at Rome. Wren's piers are shown to be excessively slender. In section, one of Michael Angelo's would nearly cover two of Wren's, the adjacent corner bastion and the intervening aisle. If entirely deprived of the buttressing effect of the bastions and the walls and arches of the adjoining parts of the church, the main piers at St. Paul's, Mr. Harvey states, would scatter, fall apart and fly to pieces in a moment. Not only are the piers overloaded, but they are excentrically loaded, and as the surrounding buttressing masses give way under the effect of vibration, wind and temperature movements and movements in the sub-soil, the duty thrown on the piers becomes more and more excessive. The fact would seem to be definitely established that Wren began the Cathedral with much less knowledge of sound architectural principles than he possessed when he completed it. In certain respects, particularly in the shape and design of the cone between the inner and outer domes, the upper portions of the structure are masterpieces of art, but in the piers and other portions in the lower part, Wren was obviously shackled by the false and unsound principles of design that were current in his earlier days.

Mr. Harvey's reasoning, if it be right, inevitably leads to the conclusion that mere strengthening of the main piers—as by the present plan of grouting into them very fluid mortar under pressure—will do little to strengthen the structure. Attention must be paid to the surrounding buttressing masses in order that they may again contribute in the requisite degree to the support of the dome weight. How Mr. Harvey proposes to save the dome has already been explained by himself in our columns. In greater detail he again states in his book the case for the suggested conic section reinforcement, whereby the weight of the dome would be adequately spread over the piers and the adjoining bastions and other masses at present untaxed.

While the main theme of the book is St. Paul's Cathedral, it also contains much of general applicability to the conservation of all ancient or decaying buildings, specific reference being made to some of the ruined abbeys of Scotland, to Tintern Abbey and to other ancient structures. To engineers, the subject is one of interest because the principles involved are at least as much of an engineering as of an architectural character. In a wider sense, too, Mr. Harvey's volume will prove enlightening and valuable to the engineer. If we would investigate the fate of modern engineering structures, or of structures in which modern engineering materials play an important part, we are faced with the fact that no such structure has yet been in existence long enough to enable us to base our conclusions on experience. We must turn to ancient buildings for guidance. The conditions in some important respects are no doubt different. We use much of our material in tension, whereas, except for the chain reinforcement round the dome, the whole of the material in the fabric of St. Paul's and similar buildings, is in compression. But the causes at work producing decay are the same or not greatly dissimilar, and by studying the failure of ancient buildings we can no doubt learn a very great deal regarding the manner in which our own structures will, if left to survive, ultimately fail. Will they give a better account of themselves than have the masonry masterpieces of the past? There are few engineers, we think, who would not be content and proud to know with certainty that 250 years hence the structures they are erecting to-day will be in no worse a condition for the fulfilment of their original duty than St. Paul's Cathedral is at the present moment.

Allen's Commercial Organic Analysis. Fifth edition. Edited by SAMUEL S. SADTLER, S.B., and ELBERT C. LATHROP, A.B., Ph.D., of Philadelphia; and by C. AINSWORTH MITCHELL, M.A., F.I.C., of London. Vol. III., Hydrocarbons, Bitumens, Aromatic Acids, and Explosives. London: J. and A. Churchill. Price 30s.

THE general editors state in their preface that this volume has been fully revised and in part re-written, and that the article on Bitumens was so nearly completed before Dr. S. P. Sadtler's death, that but few details had to be supplied by them afterwards. The contributors, whose names are given below, have supplied the articles to the present volume, and it will be seen that although there has been little alteration in the scope of the book, there has been a considerable change in the contributors. All the names will be recognised as those of men thoroughly familiar with their subjects, and each section covers very thoroughly the ground allotted to its author.

H. E. Cox (Newport, England), Hydro-carbons; W. A. Davis (Rockferry, England), (*a*) Naphthalene and its Derivatives; (*b*) Phthalic Acid and the Phthaleins; W. P. Dreaper (London), Gallic Acid and its Allies; J. Bennett Hill (Philadelphia, U.S.A.), Phenols; Edward Horton (London), Aromatic Acids; A. Marshall (Kirkee, India), Modern Explosives; John H. Sachs (Wilmington, U.S.A.), Anthracene and its Associates; Samuel P. Sadtler (Philadelphia, U.S.A.), Bitumens.

The section dealing with Benzol and its Homologues, which was formerly included in Dr. Sadtler's contribution under Bitumens, has now been transferred to Volume VI., in which it will be dealt with under Dye Intermediates and Dyes. This step has been taken because the literature of the subject of benzol has grown very large since 1918, and the present volume would have been too bulky if it had been included.

The sections on Naphthalene and Anthracene, by W. A. Davis and John H. Sachs, discuss the latest methods of testing the crude and refined naphthalene and anthracene products that are found on the market at the present time; and in the contribution on the subject of Phenol, by J. Bennett Hill, details of the analytic methods used for separating isomeric cresols from phenol, are described. The Rideal-Walker and hygienic laboratory methods for determining the phenol coefficients of antiseptics are also dealt with in some detail; while in the article on Phthalic Acids, the latest work on the subject of indicators is discussed. Finally, in the sections of the book bearing on the testing and analysis of Tars, Pitches and Oils, the methods of the United States Bureau of Mines and of the American Society for Testing Materials, have been generally followed.

The absence of the usual English trade name of "Petrol," either in the text or index, is rather remarkable, considering the importance of this commodity. The examination of, and specifications for, petrol are, in fact, dealt with in Dr. Sadtler's article on Bitumens, but here, as elsewhere throughout the volume, the American term "gasoline" is used in place of petrol. It would seem advisable therefore in the new edition, when it is called for, to have a cross reference made in the index, so that those who are accustomed to use the term "petrol," will be able to find more easily what they require. The present subject index is, in fact, much too scanty for a volume of this importance, and might be expanded with considerable advantage. The ten pages devoted to a very elaborate comparison of Fahrenheit and Centrigrade degrees might be curtailed, and in its place a good Name Index should be provided, for the name of the discoverer or patentee often assists one to trace a method or process in the pages of any book of this kind. The bibliography at the end of each section, although quite a useful addition, hardly compensates for this omission of a good Name Index.

Engineers will probably be most interested in the sections dealing with the testing of petrol or "gasoline," and with the section upon Modern Explosives, by Mr. A. Marshall, Chemical Inspector to the Indian Ordnance Department. The latter section covers the following:—Nitro-cellulose, nitro-starch, nitro-glycerine, picric acid, nitro-toluene, T.N.T., nitro-chlorbenzene, nitro-napthalene, tetryl, mercury fulminate, diphenylamine, fireworks, detonators, the Abel heat test, fume tests, moisture in explosives, and other matters; it extends to no less than 120 pages. Some interesting remarks are made upon the use of liquid oxygen as an explosive in mining by Mr. Marshall, and the following extract will be read with considerable interest by mining engineers:—"Liquid oxygen explosives are now used in Germany on a large scale for mining. They are made by soaking a cartridge of porous combustible material in liquid oxygen and firing promptly, before too much of the oxygen has evaporated away. Soot made from napthalene and contained in a cotton bag is the combustible most used. Napthalene is sometimes mixed with the soot. Kieselguhr impregnated with mineral oil has been recommended in America. The great disadvantage of these explosives is, of course, that they must be fired without loss of time."

The book, which is exceptionally well printed and bound, will prove invaluable on the shelves of all chemists and manufacturers engaged either in the analysis or production of any of the organic compounds named in its pages.

BOOKS RECEIVED.

Steam Condensing Plant in Theory and Practice. By J. Sim. London: Blackie and Son, Ltd., 50, Old Bailey, E.C. Price 18s. 6d. net.

The Elements of Machine Design. By S. J. Berard and E. O. Waters. London: Blackie and Son, Ltd., 50, Old Bailey, E.C. Price 10s. net.

The Resistance of Express Trains. By C. F. Dendy Marshall. London: The *Railway Engineer*, 33, Tothill-street, S.W. 1. Price 20s. net.

Hydraulics and its Applications. Third edition. By A. H. Gibson. London: Constable and Co., Ltd., 10, Orange-street, W.C. 2. Price 24s. net.

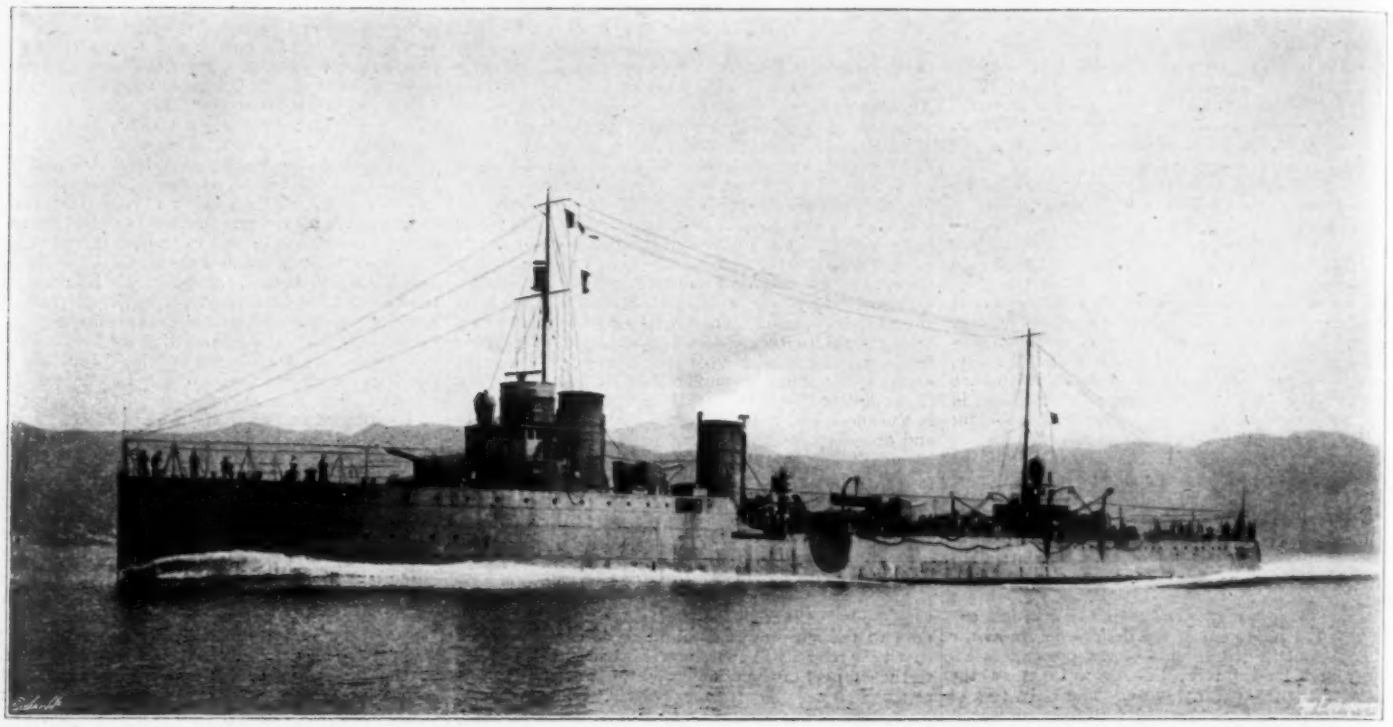
Illuminating Engineering. Edited by F. E. Cady and H. B. Dates. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

Johnson's Materials of Construction. Sixth edition. By M. O. Withey and J. Aston. Edited by F. E. Turneaure. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 30s. net.

Technical Mechanics: Statics, Kinematics and Kinetics. By E. R. Maurer and R. J. Roark. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 17s. 6d. net.

THE ITALIAN SCOUT LEONE

GIO ANSALDO AND CO., SESTRI PONENTE, BUILDERS AND ENGINEERS



New Italian Warships.

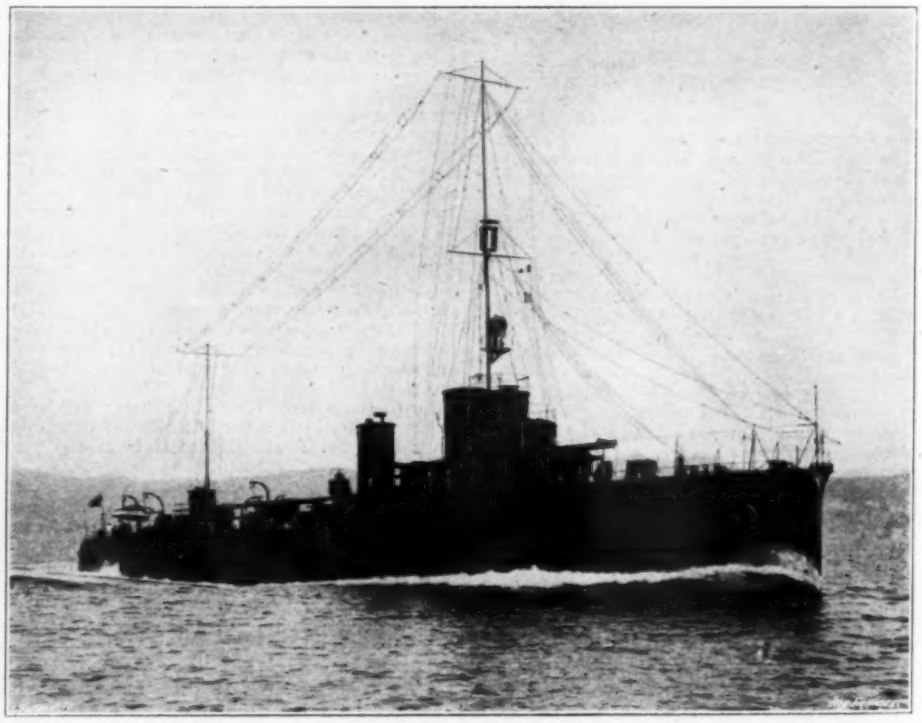
IN THE ENGINEER of April 24th a brief description was published of the three Italian scouts—Leone, Tigre, and Pantera—which were recently completed and placed in commission. These vessels have since paid a round of visits to British ports, including Portsmouth, Bristol and Liverpool, where their fine appearance has evoked well-merited admiration. Thanks to the courtesy of the officer commanding the squadron, Captain Domenico Cavagnari, R.I.N., a representative of this journal was able to make a thorough inspection of the ships during their stay at Liverpool, and it is now possible to amplify in some important respects the description previously given.

Although not very dissimilar in general pattern from the flotilla leaders of the British Navy, that designation is not altogether applicable to the Italian vessels, which appear to have been built for functions other than the leadership of destroyer flotillas. They represent, in effect, a modified version of the "light armoured cruiser" which was evolved in this country shortly before the war, though their lineal descent is traceable still further back to the "torpedo cruisers" of the 'eighties. In considering their design it is essential to pay heed to local strategic conditions. Though the staunchness of their construction is beyond criticism, it is clear that they were built mainly with a view to operations in waters more sheltered than those of the North Sea or the English Channel. Their true field of action is the Mediterranean, and it is there that their formidable powers of offence could be employed to the greatest advantage.

Naval opinion in France, and to some extent in Italy also, inclines to the belief that heavy armoured ships will be of negligible value in any future struggle for the mastery of the Mediterranean. This belief is reflected in the current shipbuilding policies of the two Powers, neither of which proposes to lay down new capital ships. Since the war they have largely devoted their attention to the building of small, high-speed ships of the destroyer type, and submarines. More recently, each has laid down several cruisers of the 10,000 class, though the utility of such ships is still a matter of dispute among their experts. In this country, seaworthiness is held to be no less important than speed in the design of a destroyer, and in order to achieve it there is a readiness to make some sacrifice of armament. The result is that the average British destroyer, while it may compare unfavourably in respect of armament with a French or an Italian boat of approximate tonnage, is probably the better sea boat. For instance, the original plan of the French "Jaguar" class, of 2359 tons, provided for an armament of six 5.1in. guns, two 3in. A.A. guns, and six 21.7in. torpedo tubes; while our 1800-ton leaders of the "Admiralty" class carry five 4.7in., one 3in. A.A., and six 21in. tubes. One of the 5.1in. guns was subsequently deleted from the French vessel, but even after that reduction in weight, she is expected to prove rather lively in a seaway. The Italian ships of the "Leone" group, though only 365 tons heavier than our "Admiralty" boats, mount eight 4.7in. guns, two 3in. A.A., and six tubes. In proportion to displacement, they are the most heavily armed ships now afloat. Since it is patent that vessels with this formidable battery are not intended to serve primarily as torpedo craft, they must be regarded as small scouting cruisers, in which the torpedo is subordinate to the gun.

Building programmes now in hand indicate that the naval forces to be assembled in the Mediterranean a few years hence will include a large quota of such ships, possessing the velocity of destroyers, reasonable sea-keeping properties, and a powerful gun armament. Much talk is heard in continental naval circles of the decisive results to be expected from tactical co-operation by swift cruisers, light scouts of the type referred to, submarines and aircraft. It is argued that a composite force of this character could absolutely close the Mediterranean against an orthodox battle-fleet of greater aggregate strength. We are not told, however, how perfect tactical co-operation is to be established between high-speed cruisers and scouts on the one hand, and slow submarines on the other; nor is it explained what these "mosquito" forces would be expected to perform against a hostile fleet, which, in addition to its battleships, was well provided with lighter satellites. Unless we admit that the coming of aircraft has fundamentally modified naval tactics—a claim which has yet to be proved—the continental theory that battleships have ceased to be of value for Mediterranean service appears to lack substance. This digression is pardonable in view of the dubious doctrines of strategy and tactics which foreign naval critics continue to preach, and which appear to be gaining not a few adherents in this country. It seems to us that of two rival forces, each consisting of light surface craft and submarines, the one that was able, at need, to command the support of battleship artillery would enjoy a very marked advantage over the other, which had no similar backing. Such, at least, is the plain teaching of experience, and our naval authorities show wisdom in moulding their policy on the old but well-tried principles until they are replaced by new rules, of which the superior efficacy has been demonstrated beyond cavil.

The design of the "Leone" class was prepared in 1916–17, probably as a retort to the heavy destroyers then being built for the Austro-Hungarian Navy, but the exigencies of war postponed the actual laying down of the ships to 1921, by which date two of the five units originally projected had been cancelled.



THE PANTERA

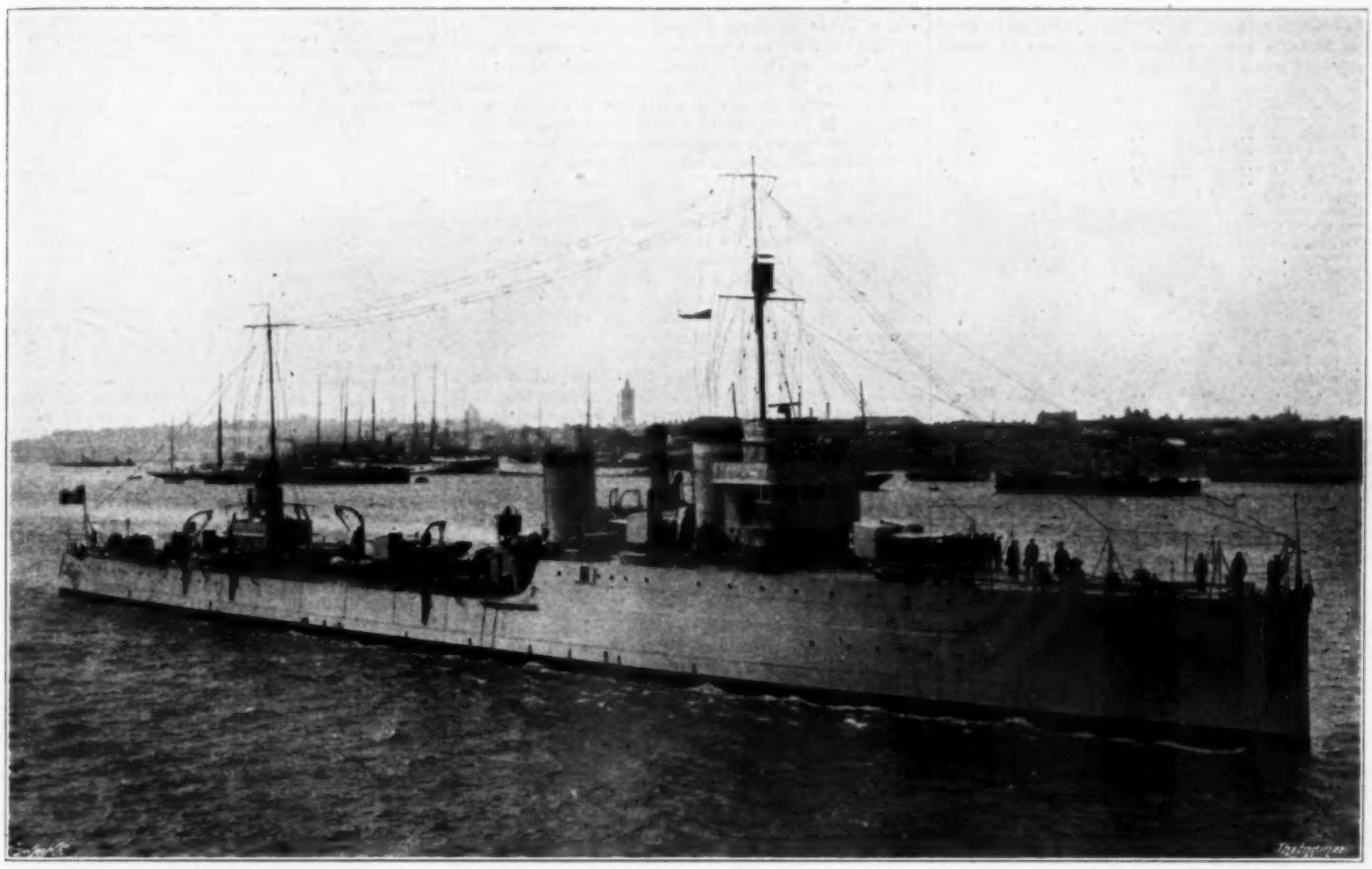
The Leone, with her sister vessels Tigre and Pantera, were built, engined, armed and equipped by the famous Ansaldo firm at Sestri Ponente, the building period averaging rather more than three years. The excellent workmanship put into structure and machinery is at once apparent to the critical eye. Despite the great importance attached to speed, the scantling is moderately heavy and the hull is well subdivided. The length between perpendiculars is 359.6ft., the extreme breadth 33.8ft., the draught 11.5ft., and the displacement 2165 tons. The freeboard at all points is considerably higher than that of our largest flotilla leaders. The general lines of the hull appear to be modelled on those of the "Mirabello" class of destroyers, which are said to be capital sea boats. There are no anti-rolling tanks, nor has the German device of employing the oil bunkers for that purpose been resorted to; yet the ships, though carrying so heavy a deck load, are remarkably steady. The long cruise of several thousand miles in which they are at present engaged has afforded frequent opportunities of testing them under varying conditions of weather, and their officers profess complete satisfaction with the behaviour of all three ships. Absence of vibration even at high speeds, and the narrow arc through which they roll and pitch, make them steady gun platforms, a quality of high importance having regard to their tactical functions.

The propelling machinery comprises two high-pressure and two low-pressure turbines of Parsons type, the former running at 3400 and the latter at 1800 revolutions per minute, transmitting power to the twin shafts through gearing which reduces the speed of rotation to 420 revolutions. On her full-power trials, the Leone developed more than 50,000 shaft horse-power, maintaining an average speed of 34.5 knots. Steam is taken from four Yarrow oil-burning boilers. Engine and boiler spaces are bulkheaded in accordance with the latest practice, and the principle of duplication has been followed so far as space and weight permit. Here and there among the auxiliary machinery one notices well-known British types, but the whole of the material itself is of Italian manufacture.

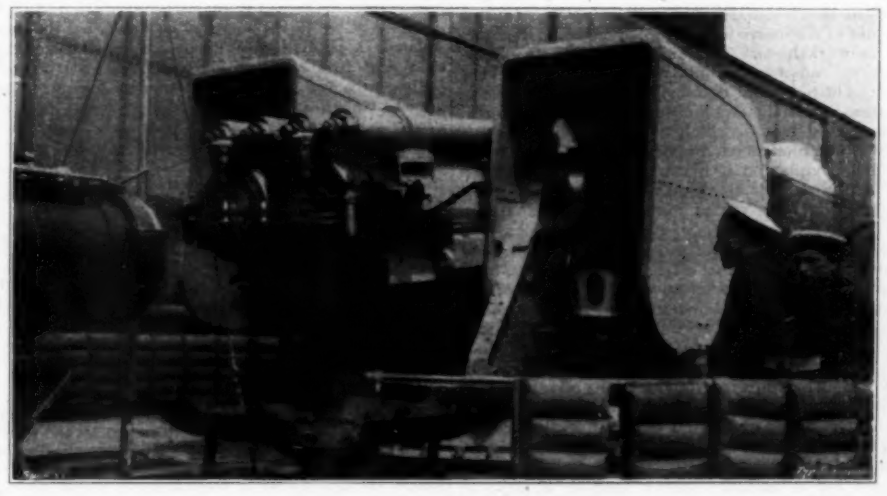
Excepting the two 3in. A.A. guns, which are placed one each side at the break of the forecastle, the entire armament is disposed along the centre line. The eight 4.7in. 45-cal. guns are on twin mountings. The first pair, being stationed well away from the eyes of the ship, can be fought even when she is running into head seas and taking water over the bows, the sighting and laying of the guns under such conditions being facilitated by an armoured shield for each of the two gun-layers. These shields are placed respectively at the right and left hand of the mounting—see the illustrations on this and on page 600—leaving a clear space between for the loading parties, who, however, are quite unprotected. The general arrangement is eminently practical, and much superior to the conventional type of destroyer gun mounting. While the two guns may be worked independently as regards elevation—maximum angle, 30 deg.—they are, in fact, operated and fired as a unit, the practice being to discharge salvos of four guns at a time. The normal rate of fire for each gun is four rounds per minute, or eight for each twin mounting. This rate could easily be accelerated for brief periods if the supply of ammunition were well maintained, but as there are only two hoists for the four pairs of guns, it would probably be difficult to keep up a continuous rapid fire. The guns, it should be added, are non-automatic, and are worked entirely by hand. They are of the Armstrong model, with a total length of 18.38ft., the rifled bore extending for 174.64in. The weight of the gun is 4.035 tons. Propelled by a powder charge of 9.6 lb., the high-explosive shell, weighing 48.74 lb., attains an initial velocity of 2460 foot-seconds. Shrapnel shell of 55.33 lb. are also used. The powder charge is enclosed in a brass case. At the time of our inspection, the guns had not been equipped for director control, but they are eventually to be fitted with "follow the pointer" gear, operated from the foretop. Each ship carries two 12ft. base Zeiss range-finders. With a well-trained crew, it is stated, there is little or no mutual interference by the loading numbers, in spite of the limited space between the two guns, which are clearly shown in the illustration. The position of the second and third mountings is such as necessarily to restrict their field of fire before and abaft the beam, but that is a defect common to all small ships with an armament disposed along the keel line.

The two anti-aircraft pieces, of 3in. calibre, discharge a high-explosive shell of 14 lb. and shrapnel of 15 lb. Italian naval officers are inclined to question the utility of these guns for the purpose in view, and would prefer a more numerous armament of 1-pdr. or 2-pdr. pompoms for use against aircraft. The six torpedo tubes, mounted on triple carriages, discharge the 18in. Whitehead torpedo, Italy having for some reason delayed the adoption of the larger torpedoes which are now used by other navies. It will be recalled, however, that the 18in. mark proved deadly to certain Austrian ships which were attacked during the war, and in which the sub-surface protection was obviously inadequate. The Austrian Dreadnought Szent Istvan succumbed to a short 18in. torpedo, launched from an Italian motor boat commanded by Captain Rizzo, in one of the most gallant exploits of the whole war. But against the modern capital ship, torpedoes of this calibre would produce little effect. In the Leone and her sisters the tubes have an unusually long "spoon," the object apparently being to carry the torpedo well clear of the ship before it is released, and also to increase the arc of fire before and abaft the beam. The offensive properties of the class are further augmented by a supply of sixty blockade mines per ship, with portable laying gear.

Taken for all in all, these ships are exceptionally powerful for their size, and appear to represent an admirable combination of the tactical qualities dictated by Italian requirements. The naval constructors



THE TIGRE AT PORTSMOUTH



TWIN GUN MOUNTING AND SHIELDS

of that country are second to none in skill. They have produced a succession of ingenious designs, some of which have visibly influenced man-of-war development elsewhere. They might claim to have invented the battle-cruiser, as typified by the Italia and the Lepanto, which were laid down nearly fifty years ago. In modern times they have repeatedly shown it to be possible to endow vessels of quite moderate tonnage with a large measure of fighting power without detriment to seaworthiness. It is because the units of the "Leone" class are characteristic specimens of Italian construction that we have dealt with them at some length. In the subjoined table their leading features are compared with those of recent British and French flotilla leaders :—

	British "Admiralty" class.	French "Jaguar."	Italian "Leone."
Year of launch	1918	1923	1923
Length (p.p.), feet ..	320	392½	359.6
Breadth, feet	31½	36	33.8
Draught, feet	12½	14½	11.5
Displacement, tons ..	1,800	2,359	2,165
Shaft horse-power ..	40,000	50,000	50,000
Designed speed, knots	36.5	35.5	35
Oil fuel capacity, maximum, tons	504	540	400
Armament	5—4.7in.	5—5.1in.	8—4.7in.
	1—3in.	2—2.9in.	2—3in.
	A.A.	A.A.	A.A.
	7—2 pr.	6—21.7in. tubes	6—18in. tubes
	6—21in. tubes		
Weight of broadside fire, lb. (main guns only)	225	300	390

The German Institution of Engineers.

(By our Special Correspondent.)

A VISIT to Germany on other business happening to coincide with the date of the general meeting of the Verein Deutscher Ingenieure, I was cordially invited by Dr. Ing. Conrad Matschoss, one of the secretaries of the institution, to become a guest at the meetings and join in the social gatherings, and it was with pleasure that I accepted the invitation. It seems more worth while to give a general account of the proceedings—as it is always pleasant to know how engineers in other lands carry on their professional work—rather than a *résumé* of the papers, because the latter will be obtainable in due course in the *Zeitschrift* of the institution. Incidentally, the opportunity will be taken to point out some activities of the German engineers upon which the writer would like to lay special stress.

The meeting took place at Augsburg and Munich, from May 9th to 11th, and about 1800 members with their relatives took part. The meeting was extended, on the one hand, by an exhibition, and, on the other hand, by excursions, so that it lasted really from May 8th to the 13th.

The programme of the meeting was printed in pocket-book format, with a cut back index. The headquarters, with literature stall—because the institution is itself a publisher—was at the Town Hall, Augsburg.

The exhibition, which opened on May 8th, was organised through the institution. It was composed of two distinct parts, each an exhibition in itself. The first part was that formed by the Arbeitsgemeinschaft deutschen Betriebsingenieure, which may be said to be a guild of engineers who organise scientific management in workshops. The aim and contents of the exhibition can be succinctly summed up in the words : Output and costs. In the words of the promoters : "Increase of output and diminution of cost are the demands which to-day, under the pressure of a common need, imperatively demand to be met. The exhibition is a summons to co-operative effort on the part of all those who have at heart the raising of the standard of management in industry and trade."

To carry out these aims, entrepreneurs are invited to send newly patented or introduced machines, tools and apparatus for engineers to these exhibitions, but nothing is allowed to be shown unless it is approved by the general secretaries, whose decision is influenced solely by the results of tests carried out by independent bodies of the status of our National Physical Laboratory. Succinct information as to the advantages of the machine over existing practice is given in tabular form on the inside of the lid of the packing case in which the object is fitted, for it should be mentioned that the exhibition is a travelling one, with an itinerary arranged for sometimes twelve months ahead. A small sum is charged to the exhibitor and also for admission of the public.

Another kind of exhibit is prepared by a firm which is admitted to be prominent in a particular branch of industry and whose name consequently is allowed to appear. Their method is exhibited in concrete form alongside the older one. Later, the Guild may adopt the method as its standard, and it is then exhibited without the name of the firm. The diagram is to be purchased in standard size in black line print or in letterpress. The exhibition of recent drawing-office equipment, filing systems, &c., with which it is important for engineers to be acquainted, is allowed, but as these things are equally well supplied by a number of firms, preference is given, to save carriage, to local firms.

Another part of the exhibition is under the care of the Deutscher Ausschuss für technische Schulwesens. This title connotes much more than technical school methods, as the name would imply, as it is really an attempt to give to the youths in engineering works comprehensive instruction of the kind that was formerly obtained through apprenticeship. A boy who wishes to enter engineering works has first to prove his fitness by simple sight and touch tests, such as judging an angle or distinguishing one out of a number of similarly shaped but different objects. Similar tests are in vogue for selecting men for other jobs, such as tram-drivers, aeroplane pilots, &c. After entry, the course is a progressive one, covering several years. Again, actual work is shown—good and bad in juxtaposition—with brief annotations—*e.g.*, a pattern with flanges and drawbacks correctly arranged beside another incorrectly made or arranged. Occasionally a piece of work of an exceptionally difficult character executed by a foreman or leading hand is exhibited, and in that case the maker's name is appended. The originals are made in the shops by the youths themselves at the expense of well-known firms who have adopted the system of schools within their own works for the training of their men. Actual copies of the originals are obtainable or, failing that, reproduction in photographic, diapositive or printed form.

It is not possible within the limits of a short article to say more of this activity, except that it is significant of an advanced spirit of co-operation, not only on the part of the firms themselves, but also on the part of the workmen and of public bodies, for it has to be remembered that everything is done voluntarily, otherwise it would be impossible, on account of expense, to carry on. The bare necessary costs of the exhibition are defrayed by an entrance fee to the general public of 6d. per person. For further details, those interested might refer to the paper* presented by Dr. Matschoss at the World's Power Conference.

The general business meeting and the sectional meetings for the reading of papers took place, as is usual, on the Saturday and Sunday. The sections were as follows :—Diesel engines (5), education (3), new methods of working (2), production of coal gas and producer gas (3), technical processes in agriculture (2), steam boilers (1). The numbers of papers presented in each of these sections is indicated by the figures in brackets, and reflect very well the amount of interest that is being taken at the present moment in these directions in Germany.

A word or two should be said about the social part of the meeting, which is considered quite important. On Saturday night there was a Begrüssungsabend, with the president of the local branch of the society in the chair. The entertainment can be described as a supper of cold meat, sandwiches and rolls, with not inconsiderable quantities of beer, interspersed with speeches, music, a filmed skit on a trip to America, much toasting and good fellowship. On Sunday at one o'clock there was an excellent dinner at the Drei Mohren, the old guest house of the Fugger family in the fifteenth century. In the evening there was a Festcommers, where much singing of national songs took place, and much beer was drunk amid much conviviality. It must be stated that these meetings are done inexpensively, evening dress is not usual, and no member is deterred by financial considerations from taking part.

Monday, May 11th, was devoted to the newly opened Deutsches Museum in Munich, in the formation and furtherance of which the institution has helped greatly. After a reception by and a presentation to Geheimrat Dr. Oskar von Miller, the principal director of the Museum, an excellent luncheon was served and parties were conducted by members of the staff over the collections. It is unnecessary to give further details here, as we shall refer to this Museum in a subsequent issue.

On Tuesday, May 12th, the visits to works and excursions—twenty-two in number in Augsburg and three in Munich—began. Of these it is unnecessary to speak, as they are of a character that is well known to all who have participated in meetings of engineers anywhere.

THE extent of the growth of the "super-power" systems of the United States is admirably shown by the statistics relating to the electricity supply industry collected under an official census covering the year 1922. These statistics, which are reproduced in the *Electrical World*, show that one-third of the energy produced in the United States is generated by eleven systems. Although in 1922 6355 systems were in operation, 106 of them produced 80 per cent. of the electricity consumed. The figures are accompanied by a map of the United States shaded to show the density of electrical development. The State of New York had the highest output in 1922, it being over 500 million kilowatt-hours. Pennsylvania and California each produced over 400 million kilowatt-hours, while the third place was occupied by Illinois with a production of over 300 million kilowatt-hours. Only ten states, including the small States of Delaware and New Hampshire, had outputs below 100 million kilowatt-hours.

* Vol. IV., p. 1700, "Co-operation of Industry with Technical Schools."

Triple Electric Locomotive for the Virginian Railway.

THE Virginian Railway was conceived and built for the sole purpose of moving coal from the rich New River and Pocahontas fields to tidewater at Norfolk. From the very beginning it has been noted for heavy rolling stock, large trains and high operating efficiency. That part of the road between Mullens, West Virginia and Roanoke, Virginia, has always offered the most difficult operating problems because of its heavy gradients, and it is now being electrified. The gradients east of Roanoke are easy and consequently the movement of tonnage on that part of the road has never presented serious difficulties.

Nearly all of the Virginian coal tonnage originates west of Elmore. At present, trains of approximately 5500 gross trailing tons are made up in the yard between Mullens and Elmore, and are moved up the 2 per cent. gradient between Elmore and Clark's Gap by three steam locomotives, whose combined weight with their tenders is approximately 1270 tons, and their combined tractive effort 409,400 lb. It is believed that there is no other place in America where such a concentration of motive power is regularly applied to single trains. From Clark's Gap, the 5500-ton train is hauled into Princeton by a single 2–8 + 8–2 locomotive. Princeton is a terminal point in steam operation. Trains operated thence to Roanoke are usually made up to about 8000 gross tons behind the tender, and are handled by one 2–8 + 8–2 locomotive, with the assistance of two "switchers" to start them out of Princeton yard and of a Mallet engine to help them up the gradient between Whitehorne and Merrimac.

The coalfields served by the Virginian Railway have hardly been scratched, and it is realised that the coal tonnage will steadily increase. The management saw that extensive improvement and additions, both to permanent way and rolling stock would be necessary to meet these traffic increases, and, after a careful analysis by engineers of the railway assisted by those of the Westinghouse Electric and Manufacturing Company, it was decided to electrify the part of the road between Mullens and Roanoke, the high voltage alternating-current system being selected.

Power for the electrification will be supplied from a power plant being constructed at Narrows, Virginia. The Virginian Railway Company feels that traffic movement should not be subordinated to power demand, and by the use of its plant the power limiting devices which usually become necessary when purchased power is used for a railway load will be obviated. Power from this new powerhouse will be fed each way on 88,000-volt transmission lines, and from these lines to the overhead catenary system by means of transformer stations situated along the right of way. In order to provide for the application of greater power to trains with growth of traffic, the transformer stations, trolley line, and locomotives have been designed for either 11,000 or 22,000 volts between the trolley and rail.

ELECTRIC LOCOMOTIVES.

The locomotives which will be used on this electrification, and the first of which has just been completed by the Westinghouse Electric and Manufacturing Company—see Fig. 1—are of what is known as the split-phase type. Power is taken from the overhead wire through the pantagraph to the main transformer, where the pressure is reduced from 11,000 to a comparatively low motor voltage. The single-phase power is changed into three-phase power by means of the main transformer and a rotating machine, called a phase converter, whence it is fed to the main traction motors. The latter are induction motors arranged for two comparatively constant running speeds of 14 and 28 miles per hour. These motors are simple and rugged in construction, and have a high weight efficiency.

The three semi-permanently coupled motive power units are operated as a single unit, and only the controller in the front end of the leading cab is used at one time. Acceleration is obtained by varying the resistance in the secondary or rotor circuit of the traction motors, a liquid rheostat being provided for the purpose. The amount of resistance is determined by the height of the electrolyte in the rheostat which is directly controlled by the engineman through the master controller. The master controller consists essentially of two parts, a speed drum for changing the motor connections to secure the desired running speed, and an acceleration drum. The control position also includes an auxiliary controller in which are placed switches for operating the pantagraph, buttons for independent operation of the different rheostats, and a button for tripping the circuit breakers.

An especially interesting feature of these locomotives is the oil insulated force-cooled transformer, the windings and core of which are immersed in a tank of oil. The oil is continuously circulated through a special radiator by a motor-driven centrifugal pump, and air for the radiator is supplied by a blower driven by the same motor which drives the pump. By using this type of transformer, the advantages of the oil-insulated transformer are secured without the expenditure of space required by the self-cooled type.

The locomotives are automatically regenerative ; that is, when descending a gradient of such amount that the net tractive effort becomes negative, the motors become generators and return power to the line. Hence, it is necessary to use the air brakes only to bring the train to a complete stop.

While the motive power units will at first normally be used in groups of three, the control, which is of the electro-pneumatic type, is arranged to permit the operation of four cabs together. Thus future traffic conditions are amply provided for, both from the standpoint of power supply and locomotive capacity. Each motive power unit has the Mikado or 2–8–2 wheel arrangement, the weight per cab being approximately 425,000 lb., so that the weight of the three locomotives is 637.5 tons. At each end of each motor shaft there is keyed a pinion which drives a jack shaft through flexible gear.

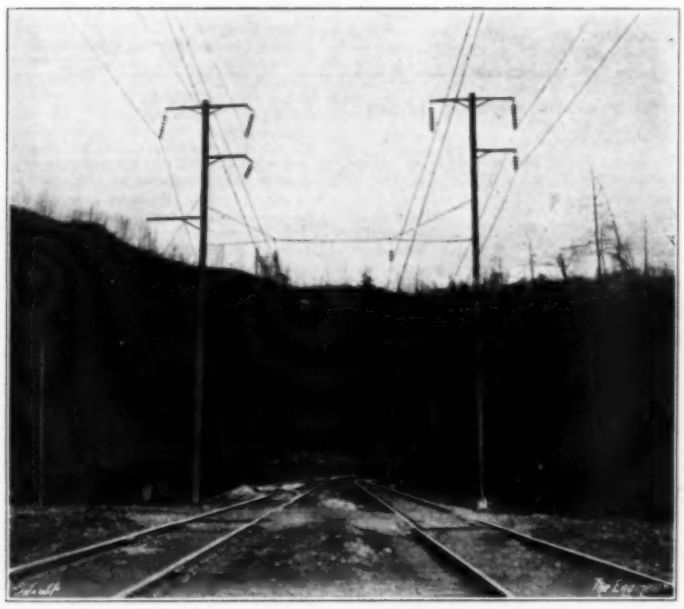
The power is transmitted from the jack shafts to the driving wheels by means of coupling rods. The two jack shafts are seen in the illustration at each end of the units. Owing to the size of the casings they look almost like wheels.

The maximum tractive effort of each power motive unit

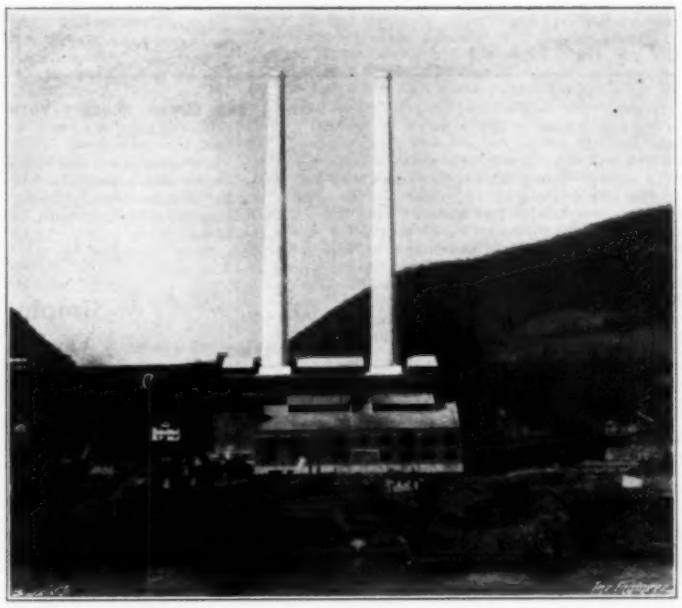
ELECTRIFICATION OF THE VIRGINIAN RAILWAY

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURG, ENGINEERS

6000 H.P. TRIPLE ELECTRIC LOCOMOTIVE



TYPICAL OVERHEAD SYSTEM ON CLARK'S GAP GRADIENT



THE NEW NARROWS POWER PLANT

as limited by electrical capacity is 92,500 lb., which occurs at an adhesion slightly under 30 per cent. At the conservative starting adhesion of 25 per cent., the tractive effort is approximately 77,000 lb. per unit, or 231,000 lb. for the three units. This is 57 per cent. greater than the compound rating of the 2–10 + 10–2 steam pusher engine and 31 per cent. greater than the simple rating of the same engines. The continuous tractive effort of the three cab locomotive is 135,000 lb. at 14.2 miles per hour and 78,800 at 28.4 miles per hour. In the high speed connection of the motors the triple locomotive can exert 6000 horse-power continuously, which is far in excess of that possible by any single steam locomotive in existence.

Electric Operation.

Under electric operation the coal trains will be made up in the Mullens–Elmore yard, as at present, and a three-unit locomotive at the head end of the train with a similar pusher at the rear end will handle 6000 gross tons from Elmore to Clark's Gap. The speed will be 14 miles per hour, which is at least double that obtained at present with steam, and 12,000 horse-power will be developed at the driving wheels. At Clark's Gap the weight of the trains will be raised to 9000 tons, and one three unit locomotive alone will take them to Roanoke. It will not be necessary to use pushers out of Princeton or up the Whitehorne gradient. The speed will be 14 or 28 miles per hour, depending upon the gradient, and the time between Elmore and Roanoke should be less than 10 hours.

The west-bound trains will consist almost entirely of empty coal cars, and will be handled by one locomotive at a speed of 28 miles per hour except from Fagg to Merrimac, from Kellysville to Princeton, and from Rock to Elmore. The weight of these trains will be about 2800 tons.

In many respects, the Virginian electrification surpasses any of its predecessors. The Chicago, Milwaukee and St. Paul electrification in the Rocky and Cascade Mountains is a marvellous example of the application of electric power to railroading. On that road there is one continuous electrified zone, equal in length to the distance from Boston to Washington, on which all classes of trains are operated electrically. Yet the tonnages handled over the Milwaukee are extremely small compared to those which the Virginian will handle. Other important electrifications, such as the New York, New Haven and Hartford, the New York Central, and the Pennsylvania, were built for reasons other than the accomplishment of economy in the movement of heavy tonnages over mountain grades. The Norfolk and Western alone stands as an example of an electrified service similar to that of the Virginian. We may add that the length of route electrified, all by the Westinghouse Company, is nearly 134 miles, or about 213 track miles. The power plant for supplying the 11,000-volt alternator current is nearing completion. It is situated at Narrows, and is shown in one of our illustrations.

SIXTY YEARS AGO.

Whatever we may think of the Government's treatment of inventors whose ideas it used during the late war, whether we consider the Royal Commission on Awards has acted generously or otherwise in settling the claims laid before it, it will be granted by most that matters in this respect are greatly more in favour of the inventor of to-day than they were in the case of the inventor of sixty years ago. The patent laws were in general the subject of much controversy and grievance, but against the Government's insistence upon its right to use for Service purposes any patent which it desired complaint was particularly bitter. It was a condition of the grant of a patent that failure to supply as required details or articles covered by the patent for the use of the Service departments would lead to the patent being declared void. The licence specified that the price and terms for the Service use of a patent were to be settled by the officers or commissioners of the Service department desiring to use the patent. It would seem that even this procedure was not thought strong enough by the Crown, for a commission appointed to inquire into the working of the patent law recommended that the Government should be empowered to use patented inventions without the consent of the patentee, payment to be made for the use at a rate fixed by the Treasury. It would even seem that when tested in the Courts, as it was in the celebrated case of Feather *v.* the Queen, the Crown could, if it chose, appropriate to itself any invention relating to the defence of the country without remunerating the inventor in any way. As a correspondent said in our issue of May 26th, 1865, the position was such that "the most exalted officers of the State are placed in the position of legalised banditti, who stab the inventor through the folds of an Act of Parliament and rifle him in the presence of the Lord Chief Justice of England." From a paragraph appearing elsewhere in the same issue it is to be gathered that a current instance of the Government's treatment of inventors was being there and then provided by the Ordnance Select Committee appointed by the War Office. That Committee, by recommending the adoption of a gaining twist in the rifling of guns and the use of bronze buttons or studs on the projectiles instead of zinc studs, in accordance with a plan which it designated the "Woolwich system," was, it was stated, using without scruple the principles of the ideas submitted by certain inventors to its care.

The new bridge which it is proposed to construct across the Niagara River between Buffalo and Fort Erie, will have four steel arches, with a total length of 1655ft. and a 360ft. Parker truss across the Black Rock Ship Canal, where the head room will be 100ft. The two approaches will have a total length of over 2200ft. The bridge is to have a 36ft. carriageway and two 5ft. sidewalks.

The Upper Reno Power Project.

THERE are some interesting features in a scheme for utilising the power of the upper waters of the river Reno, in Northern Italy, a description of which is given in the April issue of *L'Energia Elettrica*, with many illustrations, and a plan and section of the catchment. The object of the scheme, with which good progress is now being made by the administration of the Italian State Railways, is to supply electric current to the Porrettana Railway and other lines radiating from Bologna and Florence. The railway joining those cities traverses the valley of the Reno in which is situated the smallest of the four reservoirs of the group, near Molino del Pallone. The other reservoirs are within a few kilometres of the railway, at Pavana on the Limentra di Sambuca, and at Suviana and Castrola on the Limentra di Treppio, tributaries of the Reno. The reason for forming only one small reservoir in the valley of the Reno is that the railway runs along the valley bottom, while the topography and the strata in the other valleys are favourable for the building of large dams. By completing first the Molino and Pavana dams, it will be possible by means of a power station below the latter to supply current during the years that will elapse before the larger dams in the valley furthest from the railway are completed. The waters of the Molino catchment of 91 square kilometres will be passed on to the Pavana dam, the separate catchment of which has an area of 41 square kilometres. When all the works are finished, both these dams will serve as diversion weirs for the supply of the larger reservoirs. The connection from the Molino reservoir to that of Pavana will be a tunnel of 24 cubic metres per second capacity and 2840 m. long, the respective water surface levels being + 474.5 m. and + 470 m. From the Pavana reservoir to the Suviana reservoir in the adjoining valley, the connection is a tunnel 2796 m. long and of 36 cubic metres per second capacity; water levels, + 470 m. and + 468 m. The available catchment of the Limentra di Treppio is 102 square kilometres, of which an area of 74 square kilometres is upstream of the Suviana dam, which will supply a central station at an altitude of + 378 m. The Castrola reservoir, immediately below it, will, as one alternative, supply a central station at an altitude of + 320 m., the water level of the reservoir being + 382 m. Just downstream, there will be a compensation reservoir, from which a pressure pipe will take the water to the central station at Riola. The other alternative is to combine these two falls and leave out the central station of Castrola, the matter being not yet decided.

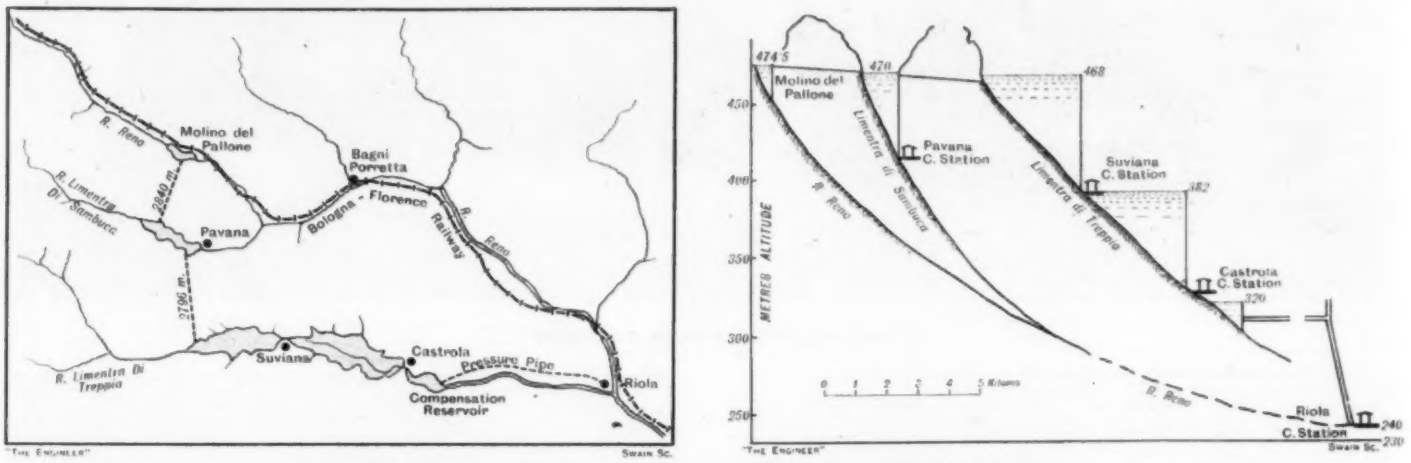
The group of reservoirs will, it is estimated, ensure a constant supply of 8 cubic metres per second. The upper fall of 80 m. will develop from 25,000 to 30,000 kilowatts, and the total power developed will be 100 million kilowatt-hours per year, some 12 million being available as soon as the works are completed as far as the central station at Pavana. Rainfall and run-off records are considered fully to justify the scope of the works, the run-off figures for 102 square kilometres of catchment in the years 1920-1924 inclusive being :—Mean run-off in cubic metres per second ("mecusecs"), 9.05, 7.53, 10.18, 10.20, and 8.73.

The dam at Molino del Pallone is 60 m. long, 12 m. in height, and is built entirely of concrete. It has a weir 14 m. long and 3.3 m. deep over sill, provided with counterpoised automatic shutters. There are also two openings of 4 m. by 3 m. to serve as scouring sluices.

The Pavana dam will be 400 m. long and 52 m. in height above the mean level of foundations, and will have a volume of 34,000 cubic metres. The middle part will consist of three arches, inclined at 62 deg. to the horizontal and resting on two piers, and the two suitably developed ends of the solid portions forming the flanks of the dam. The piers are 16.5 m. apart, centre to centre, and range in thickness from 2 m. at the top to 5 m. on the foundations. The upstream faces of these piers are of constant width, in order that the work of forming the intrados of the arches may be simplified. The extrados takes the usual form of a portion of a truncated cone. The arches are reinforced for water heads ranging up to the maximum of 42 m. The upper end of the arch is developed as a semi-cupola, with its vertex at 4 m. below maximum water level, and as the fluctuation of water level will be 3.3 m., the arches will always be under water. The semi-cupola is prolonged over vertical arches, and an apron parallel to the main arches and supported by inclined arches provides the upper part of the water face. Over all are vertical arches supporting a roadway.

The gravity dam at Suviana, which is to be slightly curved in plan, with a radius of 550 m., will be of triangular cross-section, the dimensions being calculated on Levy's formula. As it will be a very high dam, the main dimensions are worth some attention, and from those now to be given a cross-section can be drawn :—Roadway, 5 m.; parapet, an additional 1.50 m. in width; from upstream edge of parapet, a vertical of 3.50 m.; thence a batter of 7½ in 100, forming the upstream face, and from the same point a batter of 81.53 horizontal to 100 vertical, forming the downstream face; centre of radius joining this face with the vertical downstream face of the crest, about 7 m. below crest; radius, 12 m.; width at base, 75.68 m., at alt. 385; apex of triangle, alt. 470 m.; water level, 468 m.; crest, upstream parapet, 473.5. The foundations are shown in zig-zag, about 1½ m. below alt. 385, and at the upstream end there is a cut-off trench 6.0 m. deep and 4.0 m. wide. The filled-in river-bed level is at 395. The height of the dam above river bed is 88.6 m., and the height above foundations, as shown, about 90 m. The freeboard is 5.5 m., and the water head over the bottom of the cut-off trench is about 91 m.

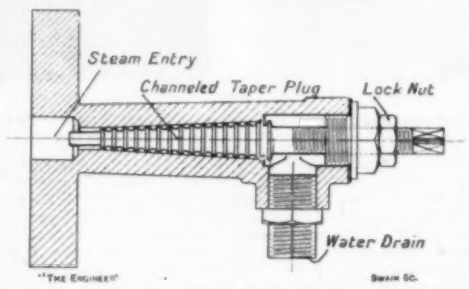
The dam, which will be 200 m. in crest length, and have a volume of 260,000 cubic metres, is far from being a free gravity dam, for the longitudinal section shows that its maximum height applies to only about 22 m. of its length. Over a length of 50 m. the height ranges from the maximum to 68 m. at each end of this portion of the dam. The gorge is, in fact, a very good one for the erection of a mass dam of the gravity-plug type, the plug effect being enhanced by the slight curvature in plan.



UPPER RENO POWER PROJECT—PLAN AND DIAGRAMMATIC SECTIONAL SKETCH

A Simple Steam Trap.

WE recently examined a new form of steam trap which is being introduced in the British market by E. Lassen and Co., of 109, Kingsway, London, W.C. 2. It is, we understand, of French origin, and is made under the Massip patents. The principle upon which the trap works will be made clear by the accompanying illustration. Within the cone-shaped body of the trap, which may be made either in phosphor bronze steel or cast iron, according to steam pressure and service is fitted a central channelled plug with a long taper. The plug is continued through a packing gland and is provided with a locking nut and a squared end for adjustment. The water collecting in the trap finds its way through the grooves of the channelled plug and passes out to the drain.



THE MASSIP STEAM TRAP

To set the trap all that is required to be done, so we are informed, is to slack off the plug until a good flow of both steam and water is passing through the trap. The plug is then closed to such an extent that only water accompanied by a little vapour can escape. After this condition has been reached the plug is turned slightly in the reverse direction and secured in that position by the lock nut. The reason for thus giving the plug an opening slightly in excess of that required at the time, is, the makers point out, the fact that after working for a day or so there is a tendency for the trap to restrict the delivery, after which it settles down to normal working.

When once adjusted no attention is, we are informed, required, and the plug only needs to be withdrawn and cleaned after long intervals of service.

It is claimed by the makers that the resistance offered by the grooved plug to the passage of steam is so great that there is no loss of steam even though the pressure of the steam and the quantity of water to be passed varies in amount. The trap also, it is said, has the advantage that it can deliver the condensed water to levels proportional to the pressure of steam in the supply pipe, so that it is not necessary to fix a non-return valve in the delivery system. It is recommended, however, that a direct water by-pass connection should be fitted in cases in which a quick discharge of accumulated water is required, as, for example, when beginning a heating operation. The trap we have described is made in standard sizes for low, medium and high-pressure work, and a special design for large outputs of water is also stocked. It is estimated that in France alone some 10,000 steam traps of this type are in operation, and, we understand, that in this country they are already employed in laundries and chemical works, and in industrial processes which require steam heating.

DEMOLISHING THE NIAGARA CANTILEVER BRIDGE.

THE work of demolishing the cantilever bridge across the Niagara gorge is progressing rapidly. As soon as the new steel arch bridge, which was described in our issue of May 1st last, was put into service, the work of razing the cantilever was begun. It is the first time that a structure of a size comparable with that of the cantilever bridge has been taken down in the manner in which this steel link between the Dominion of Canada and the United States is being removed. Piece by piece, it is being cut away by use of the acetylene torch, and the great mass of steel in it will become scrap.

The start of burning out the bridge was made over mid-stream, on the comparatively short truss that connected the cantilever arms. A portion of that truss was dropped into the river 200ft. below, but it is only by accident or special intent that any of the steel is permitted to get away by the river route. On each side of the river, on the *débris* slopes of the high bank, timber falseworks have been erected to support the shore ends of the cantilever arms as the bridge is removed. Similar falseworks were used in the erection of the bridge in 1883. Ever since that year the cantilever has afforded crossing of the Niagara Gorge and River for trains of the Michigan Central Railway, but increasing weights of rolling stock, coupled with increased length of trains, made a new bridge an absolute necessity.

The use of the acetylene torch in removing such a structure as this bridge indicates the progress made of recent years with that method of demolition. When the bridge was built acetylene gas was almost unknown outside the laboratory, and it was not for a decade or so after Willson discovered in 1892, that calcium carbide could be manufactured commercially in the electric furnace, that the use of the gas for anything but illumination purposes was attempted.

The work of removing the cantilever will take all the summer. There was a desire on the part of many to have the bridge left standing to provide much-needed additional facilities for self-propelled traffic between Canada and New York State, but that course was, for several reasons, found to be impossible.

THE INSTITUTION OF MINING ENGINEERS.

As previously announced, the eighty-third general meeting of the Institution of Mining Engineers will be held at Cardiff on Tuesday, Wednesday, and Thursday, June 16th, 17th, and 18th, 1925. The Council of the South Wales Institute of Engineers has placed the house of the Institute at the disposal of the Institution as headquarters during the week commencing on Monday, June 15th. In view of the prevailing conditions in the coal industry, it has been decided to confine the programme to formal gatherings and visits of technical interest. No arrangements are therefore being made for pleasure excursions in which ladies could take part.

The following is the provisional programme of the meeting :—On Tuesday, June 16th, at 11 a.m., there will be a general meeting in the Lecture Theatre of the South Wales Institute of Engineers, Park-place, Cardiff, when the Lord Mayor of Cardiff (Alderman W. H. Pethybridge) and the president of the South Wales Institute of Engineers (Mr. H. Spence Thomas) will welcome the Institution on behalf of the city of Cardiff and the Institute, respectively. The following papers will be submitted for discussion :—(1) "Petroleum Refining in South Wales," by Sir John Cadman, K.C.M.G.; (2) "The Maximum Efficiency of Heat Engines and the Future of Coal and Steam as Motive Agents," by Dr. J. S. Haldane, F.R.S.; (3) "The Shutting-off of Gob Fires in Gassy Seams," Memorandum by the

Gob Fires Committee of the Institution: (4) "Spontaneous Combustion in the South Wales Coalfield," by J. Ivon Graham and T. D. Jones; (5) "The Principles and Operation of the Mines (Working Facilities and Support) Act, 1923, Part I." (paper read before the Midland Institute of Mining Engineers and discussed before the other federated Institutes), by John H. Cockburn. At 3 p.m. the party will leave the Engineers' Institute by char-à-banc to visit the Melingriffith Tin-plate Works of the Melingriffith Company, Ltd., Whitchurch, where tea will be provided by the invitation of the company. At 7 p.m., by the invitation of the Monmouthshire and South Wales Coal Owners' Association, members will be entertained at dinner at the Park Hotel, Cardiff.

On the Wednesday, at 8.45 a.m., the party will leave Cardiff (G.W.R. General Station) by special train for an all-day visit to the Llandarcy Oil Refinery Works of the Anglo-Persian Oil Company, Ltd. At 7 p.m. the dinner of the Institution will be held at the Park Hotel, Cardiff. On the Thursday, at 9 a.m., members will leave Cardiff (Rhymney Station) by special train for the Britannia Colliery of the Powell Duffryn Steam Coal Company, Ltd. The Britannia Colliery, the Bargoed Power Station, and the Bargoed Colliery and By-product Works will, alternatively, be open for inspection by members. Luncheon will be taken at Britannia Colliery, by the invitation of the Powell Duffryn Steam Coal Company, Ltd. The return to Cardiff will be made by special train, arriving about 3 p.m., and at 3.30 p.m. the party will leave Cardiff (Rhymney Station) by char-à-banc to visit the Cardiff-Dowlais Works of Guest, Keen and Nettlefolds, Ltd.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

THE improvement in demand for structural steel in the Midlands has not been maintained, but there are a few hopeful features in the trade position, and iron and steel masters are not dismayed, though, admittedly, the situation gives cause for much anxiety. Here and there, symptoms of a developing demand for engineering materials are to be met with, but actual business is slow in coming. Prices are maintained for the most part on last week's basis, though consumers continue to press for reductions. Competition in most branches of the market is extremely acute, and a good deal of the business available is going to the Continent at figures with which it is quite beyond the power of local producers to compete.

Steel Position.

The improvement in demand for structural steel has not been maintained, and the call for all classes of steel material on 'Change in Birmingham to-day—Thursday—was small. Prices are fairly stable, angles and joists commanding £8 10s. and tees £9 10s. The general figure for ship, bridge and tank plates sold in this district is £9 5s., although lower figures are accepted in the North of England, a disparity which tells against Midlands engineers. Boiler plates are £13 and Staffordshire hoops £11 10s. at works. Small steel bars are now generally quoted at £8 15s., firms that had stood out for 5s. more having come into line. There is only a quiet demand for strip. Foreign material can be delivered here at £6 15s., underselling the English product, and this foreign material is largely being employed by constructional engineers who have a good deal of work in hand. Plates and sheets also are decidedly below English prices, and imports tend to increase. The steel-making firms find it impossible to compete with foreign prices. Statistics have been prepared which it is intended to lay before the Government, and the possibilities of co-operative action are the subject of consultation by leading representatives and firms. Many steel makers favour a system of pooling the orders, with a view to dividing the various products required among firms specially laid out for the production of plates, joists, bars, &c., somewhat on the German system. For soft steel billets from native mills, the general basis is £7, though transactions have been made at slightly below that figure. One large Welsh concern continues to take orders at £6 15s., but that appears to be the lowest figure. On the other hand, Belgian makers can deliver here at £6 2s. 6d., and the Staffordshire re-rolling firms in the majority of cases are using Belgian material.

Manufactured Iron.

Demand for Staffordshire finished iron improves but slowly, and then only in the first-class and medium grades. The marked bar houses maintain their basis price of £15 without difficulty, and most of the mills are fairly well occupied. Very few Crown quality bars are being sold, even though many producers are prepared to shade the £12 15s. figure. The Staffordshire mills are largely at work because they can buy billets at £6 and £6 2s. 6d. against the lowest English price of £6 15s. The Staffordshire iron trade has to contend, not only against the superior cheapness of steel as against iron, but the possibility of buying No. 3 Belgian iron for nut and bolt making at £7 2s. 6d. delivered. Native nut and bolt iron is cheaper at £11 10s., but obviously competition is out of the question, even when the superior quality of the local material receives its full credit. Deliveries of this material to the Black Country from Belgium continue on a liberal scale.

Increased Call for Sheets.

There has been a much better demand for galvanised corrugated sheets this week, and manufacturers have further strengthened their position, some of them having filled up their order books till August. South America is again in the market, and it is reported that better shipments are in prospect for the Far East, with which trade has for some time been extremely sluggish. Values of 24 gauge corrugated sheets remain firm at £16 10s. f.o.b., with 5s. additional for home business.

Raw Iron.

Pig iron remains very dull, but the position is no worse, and, generally speaking, last week's quotations obtain. Prices of foundry numbers are steadier than recently, but there is very little call for forge numbers. Northampton foundry brands can be bought at £3 9s. and Derbyshire £3 15s. Consumers continue to buy only for immediate needs, hoping that prices will fall further. Furnace coke is cheap and plentiful, and on this consumers base their hopes of lower prices. There are once again rumours of a descent of continental pig iron producers on the British market. There is very little danger that invasion of this district will be repeated, however, for a quotation of £3 11s. at Antwerp for No. 3 foundry means, with freight and handling costs added, over £4 10s. at Midlands works, and on that footing furnacemen at home can claim a substantial advantage. The closing down of furnaces last month has made no apparent difference to the excess of supplies over demand, nor can it till surplus stocks have been reduced. Orders are being given out only in driblets, consumers being pretty unanimous in the policy of running their works on the lowest margin of raw material stocks.

Scrap.

Steep scrap is difficult to sell, although prices have further weakened, especially steel turnings, which can be bought for the very low figure of £2 per ton.

The Miners' Decision.

Industrialists hereabouts are generally agreed that the miners showed considerable wisdom when at the delegate conference at Blackpool they decided to continue their joint investigations with the mineowners of the condition of the industry. A direct consequence of their action will be that there will be no notice given to terminate the existing agreement in June. It would appear that at last it is being realised that the hard lot of the miner is not due to any desire on the part of the employers to wring profits out of the pits at his expense, but to the general depression which has settled upon the industry. Further, one may conclude that in face of the disquieting facts which the conference has already revealed, leaders and rank and file are beginning to modify their views concerning what is and what is not economically possible for the industry. If this be so, a real move forward has at last been made. There is some room for hope now that the men's leaders will think better of the programme they were obviously meditating a little while ago. What may be the result of the joint committee's labours is problematical, but, at least, all the facts will be known, and it will then be possible to think about improving the miner's financial return for his work in the pits, not by increasing his wages without consideration of other economic aspects, but by taking measures to revive the entire industry, and thus confer upon him the permanent benefit of a wage based on general prosperity.

Cannock Chase Coalfield.

At Cannock Chase and in the Warwickshire coalfields, where a large proportion of the fuel raised is for domestic use, employment cannot be expected to maintain the steadiness with which it has hitherto withstood the crisis. During the past week a considerable slump has been experienced, and most of the pits are on short time. Substantial stocks of coal and slack are being carried by the collieries, and, if the warmer weather continues, there is little prospect of local trade improving. There is only a moderate demand for fuel for industrial purposes, and little help can be expected in that direction. Industrial consumption is declining rather than expanding. The iron and steel trades, ordinarily powerful auxiliaries of the collieries, are not operating at more than about half capacity.

Rolling Stock.

Midland rolling stock firms continue fairly busy, with medium order books. They are successful in securing orders from time to time which, with the substantial contracts given out by the home railways some months ago, keep the shops steadily employed. There are evidences of additional work in the near future. South Africa wants carriages, and India has not yet fulfilled its development programme. More rolling stock is required in South America, but the necessary capital is not forthcoming for the railway extensions which have been provisionally planned, and current orders are only for small numbers of carriages and wagons for existing systems. At home the equipment of the Cheshire Lines is to be strengthened. There is, unfortunately, practically no demand for private traders' wagons.

Edge Tool Industry.

The heavy edge tool industry in the Midlands is in a fairly satisfactory condition. A temporary rush of business has speeded things up considerably in the last week or two, and some firms are working overtime. The business emanates chiefly from the East, with the Indian trade better, but the position is marked with the usual characteristics. There is no forward buying, and the boom is not expected to be prolonged.

Unemployment.

Unemployment in the Midlands continues to decrease. The current total of 133,567 records a decrease of 573 over the previous week and is 1337 lower than the return issued a fortnight ago. The number of workless in the Birmingham area has this week fallen slightly, the present total being 26,302, compared with 27,639 last week, a decrease of 1337. At Coventry, where the motor engineering establishments are working at full pressure, the number of workless is down to 1285, which is 7 fewer than a week ago. Decreases are also reported from Bilston, Cradley Heath, Derby, Dudley, Leamington and Warwick, Leicester, Oldbury, Peterborough, Redditch, Stoke-on-Trent area, Stourbridge, and Brierley Hill, Walsall, Wolverhampton and Worcester.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE feeling in the Manchester district with regard to the future of the markets is rather depressed this week, and even sellers and manufacturers of iron and steel seem now to have given up the optimistic outlook, although they do not admit that prices can go much lower. One cause of this local feeling is, of course, the approach of Whit-week, for it is realised that there is no chance of any improvement now until the holidays are out of the way; and, in fact, most people believe that the autumn must come before any improvemnt can set in. The question of the moment is whether the general level of prices can be maintained during this long period of waiting for the time when improvement is considered to be a possibility. At the moment the only thing which prevents all the prices from coming down with a slump is the cost of production, and, of course, it is known that this influence alone cannot permanently hold them up.

Metals.

In the copper market one finds much the same scepticism as to any rise of prices in the near future as is found in the iron market. The position, of course, is not so bad in copper, because for years the market has been near the bottom, and there is not much room for any further fall. Moreover, when a market has remained fairly steady at low prices for a long time, there is always a much better chance of revival. The immediate future of copper seems to depend partly on a possible revival in the American domestic consumption, and partly upon the ability of Germany to buy what she evidently needs. Just at the present moment German buying of copper is badly hampered by her financial difficulties; but one cannot think that these can stand permanently in the way if the metal is wanted for legitimate industrial expansion. It is a little difficult to be sure how far the American schemes for the curtailment of copper output will be carried out. No doubt something will be done in that direction, and if it be persevered in for a year or so, we may get output and consumption into a better relation with one another; more especially if further progress is made in the rehabilitation of industry. There does not, however, seem to be any immediate probability of any upward rush in the copper market. The big differences between manufactured copper and brass and the actual costs of the raw materials are still maintained, and take their share in hampering the consuming industries. In the market for tin sentiment seems to be improving again, and sellers here are beginning to speak very confidently about a higher range of prices. It must not, however, be forgotten that between the middle of April and the present date some £20 has been gained, and this must be a temptation to those who bought three months' tin at the lower price. The position is, of course, very uncertain, and it is well for the outsider to keep clear of obligations. Here consumers seem to be buying chiefly from hand-to-mouth, and in small lots, which is perhaps the safest thing to do. The market for lead has been fairly steady, but there is a feeling that supplies are likely to be plentiful, and that the price is quite high enough. A further upward move in lead prices seems now to be very improbable, the chances being rather the other way. Spelter has been quite a firm market, partly owing to the withdrawal of offers from the Continent. The demand from consumers is steady but not very active.

Pig Iron.

The market in Manchester for foundry and forge pig iron is quiet and dull, but, of course, nothing else could be expected this week when most people are preparing for the annual holiday. Business will be practically shut down next week, although there is a perfunctory meeting on the Exchange. There is still some small buying of foundry iron going on, and the prices are much the same, but consumers are expecting further concessions after the holiday. Whether it is possible for Derbyshire makers to come down to 80s. in Manchester for No. 3 remains to be seen; and another doubtful question is whether buyers will, when such a level price is reached, begin to stock pig iron for future use. At present this is thought likely; but it is generally the case that prices have to begin an upward movement before consumers will come freely into the market. On this theory the reduction of 2s. 6d. would only be taken as an encouragement to wait for another 2s. 6d. Although there have been reports of "cut" prices for Northampton foundry iron, one may say that the Derbyshire makers have the South Lancashire market to themselves. A little Staffordshire and Lincolnshire iron is heard of occasionally, but the quantities offered are trivial. The demand for forge pig iron is very poor at present. Iron manufacturers still find wrought scrap a cheaper material, although forge pig is to be had at about 77s. 6d. per ton delivered. For Scotch pig iron 101s. 6d. is still quoted here, but there is very little demand. Hematite may be had at about 92s. 8d. per ton delivered, and there is perhaps a better sale for it, although the demand is not great.

Steel.

Merchants dealing in the manufactured section of the steel trade do not report any improvement; but this was scarcely expected yet even by the most optimistic. The only question is whether prices can be kept up until the improvement comes. Nominally there is no change in the quotations, which remain at £8 10s. for sections, £9 5s. for plates, and £9 to £10 for bars, but, of course, these are the ostensible prices. Business seems to be done privately at some concession on these prices, when it is done at all; but there is not much moving at any price.

Scrap.

Dealers in scrap iron and steel seem to be more depressed than ever this week. Of course, they ought not to expect to do business, but they seem now to be afraid of buying at any reasonable price. Steel scrap is a very uncertain proposition, for no one can tell what consumers will be prepared to pay when buying is resumed. Apparently dealers are now afraid to give more than 50s. per ton for heavy steel melting scrap of ordinary quality. Heavy wrought scrap is not safe to buy unless it can be delivered at the forges for something under 75s. per ton. Iron-founders are not buying much cast scrap this week, and their idea of price is now 75s. per ton delivered. Dealers, on the other hand, are holding out for 80s., although one hears that 77s. 6d. has been taken.

BARROW-IN-FURNESS.

Hematite.

As was suggested in these notes a short time ago, there is every likelihood of an early damping down of some of the furnaces in the district. Business has not improved, and stocks have been increasing at most works until they have reached such proportions that customers can be supplied for some time from them and the furnaces can be laid idle. The Millom Company is restricting its output, but in its case the stocks are not big. There are rumours that other works in the North-West district will follow suit, and if the steel departments stop for want of orders, there will be a further argument in favour of reduction of output. The hematite pig iron trade is very dull indeed, and there is no sign of an improvement; at present it is rather the other way. Some makers of iron have not come to a definite decision as to stoppage, but it will be arrived at very shortly, for the demand is small from all sides. Scotland is taking very little and the Midlands are ordering on a small scale. The Continent is a very poor customer, but as regards America, there is still some business being done, and that may help to keep a furnace or two in for a longer period until the American requirements are satisfied. Special qualities of iron are in poor demand.

Iron Ore.

The iron ore trade is threatened by the stoppage of furnaces in the district, and it is regarded as certain that there will be a reduction of workers in the various mines. At Hodbarrow the men are working from day to day, and are liable to be stopped at 24 hours' notice at any time. Little ore is going out of the district. There have been the usual shipments of ore from Spain, &c., but there will be a restriction in them in the early future.

Steel.

The steel trade is quiet and the shortage of orders is likely to stop the mills in the district at any time. At the time of writing the Barrow rail mills are working, but unless there are fresh orders booked this week, there seems every chance of the mills being idle after the Whitsun holidays. The position in Workington is very similar both as regards rails and sleepers.

Shipbuilding.

Vickers, Ltd., will launch from their Barrow Naval Construction Works the Orient liner Otranto on June 9th. This vessel is sister ship to the Orama, and will be one of the largest and speediest passenger ships running to Australia. Satisfaction is expressed at the confirmation of the Australian order for two submarines, and gun mountings for one of the cruisers being built on the Clyde.

SHEFFIELD.

(From our own Correspondent.)

The Crude Steel Trade.

ALTHOUGH some centres of the iron and steel industry in the country report a few signs of trade improvement, there is no relief to the depression of crude semi-manufactured steel in this district. The same remark applies to raw materials. For common pig iron and scrap, there is scarcely any sale, and rates have to be cut very fine indeed in order to secure contracts. The price of 79s. per ton, or even less, is being accepted for Derbyshire foundry iron delivered here, and only a few of the foundries are consuming any weight of material. Forge iron hardly sells at all. For heavy basic steel scrap, a price as low as about 67s. 6d. per ton is being asked, while steel makers are offering half-a-crown less.

The Finished Trades.

On the heavy side of manufactured steel, the principal line is still railway work. A good many orders are on hand from the home companies, but the bookings from overseas are on an unsatisfactory scale. It is reported that the United Steel Companies, at their Workington branch, have secured an order for 5000 tons of rails for an Indian company. The Hull Tramways Committee has accepted the tender of Vickers Ltd., of Sheffield, for a large number of tramway axles. Judging by a speech made in the city last week-end by Mr. R. Storry Deans, one of the local Members of Parliament, there is a prospect of the armament departments securing more work from the Government at no distant date. Mr. Deans was guarded, but what he said was hopeful. He stated that he had been having a little chat on the subject of the Navy with persons high up in authority, and, although he could make no promises, he should not be surprised if before the end of the year those in Sheffield who were interested in the Navy from the practical point of view heard some good news. In the engineering trade, activity is mainly confined to special contracts. For machine tools and other ordinary lines, the demand is quieter than for some time past, while there has been a marked decline in the bulk of foreign orders for textile machinery. A point of interest about stainless steel is the announcement that a church spire in the city, which is now undergoing repair, is to be terminated by a great cross of this material. The cross is now in the hands of Thos. Firth and Sons, Ltd., the well-known makers of stainless steel.

A Works Restarted.

I recently reported that the old-established Effingham Nut and Bolt Works of George Cooper and Sons, Sheffield, had been purchased by Thos. W. Ward, Ltd. The works were closed by the liquidator, but the purchasers have now restarted them, being largely influenced to do so by a desire to prevent additions to the ranks of the unemployed. They have re-engaged most of the hands. They are also dismantling many of the old machines and replacing them with new appliances, and when this operation is completed the works will be among the most up to date in the trade.

Cutlery and Plate.

Activity in the cutlery and plate trades keeps up to a moderate extent, although it has made little recovery from the setback experienced three months ago. A few large firms have recently benefited by a number of valuable orders for high quality goods, placed by steamship owners and railway companies. Included in one of these orders was the cutlery outfit for two large liners, consisting of about 6000 ivory-handled table knives. The export trade is well maintained, especially to Australia, although the tendency of the Commonwealth to buy goods of the cheaper qualities is growing. A recent addition to the products of the Sheffield cutlery trade is the grape-fruit knife. It is of small table size, with two edges, one of which is sharp and the other serrated, and the end of the blade is curved or bent upwards.

Railway Rates Handicap.

Steel manufacturers have for long been complaining of burdens which handicap them in their efforts to secure orders in face of home and foreign competition. Among these handicaps are heavy taxation, both national and local, and high railway rates. Regarding the last-named item, the Park Gate Iron and Steel Company has just published a striking statement. It takes the cases of pig iron, ingots, blooms, &c., plates, sheets and bars, and gives comparative figures for 1913 and for 1924. Reviewing the situation, it states that "the average cost of railway carriage is over 50 per cent. more than pre-war, whilst the selling price of steel is only about 30 per cent. more. The increased charges represent 5 per cent. on the total cost of production, or 15 per cent. of the difference between the selling price of finished steel in 1913 and 1924. The increase means to the company over 10s. per ton on the finished product, or a total increased expenditure of £50,000 to £60,000 in the year. Steel prices to-day are in many cases at or below cost, and the industry is not in a position to carry this extra burden."

Abolition of Level Crossings.

A great scheme for the abolition of level crossings over thirteen roads is in prospect at Hull, and the expenditure of over a million and a-quarter sterling is foreshadowed. Some details were given last week at a meeting of the City Councillors and heads of Corporation departments, and this week the matter was to be formally submitted to the Council. The Ministry of Transport has been asked to contribute two-third of the cost, or about £810,000. The London and North-Eastern Railway Company has agreed to give £100,000, besides 30 acres of land valued at £15,000. The proposal is that the city should provide the balance of £305,000, of which the tramways undertaking would contribute £10,000 per annum for five years. The scheme, which would afford employment to 1300 men for five years, provides for the removal overhead of several crossings, and also for the abolition of three, among which is one over the main Anlaby-road, which would be obviated by diverting the main Goole, Doncaster and London line through the Fair Ground, cricket ground and West Park.

A Doncaster Coal Development.

The valuable Parkgate seam of coal has not hitherto been tapped in the great Doncaster coal area, but it is now to be worked at Brodsworth Colliery. The pit has three shafts, and the Parkgate coal will be drawn from shaft No. 2, which has been carried to a considerable depth below the Barnsley bed, the new sinkings having been done while the normal work of the colliery was in progress. The Parkgate seam in the district is 5ft. 6in. thick. The development will mean a substantial increase in the output of the colliery, which is already on a very large scale, and has a record of something like 30,000 tons of Barnsley coal in one week.

A Railway Innovation.

The Derwent Valley Light Railway, between York and Selby, has adopted a new type of light steam locomotive, specially made for the lighter kind of work, whether passenger, goods or shunting. The engine was successfully tested one day last week, and was then put into regular service. It is named the Sentinel, and was built by the Sentinel Wagon Works, Ltd., Shrewsbury. It weighs 20 tons. Attached to it, on the trial run, were a dynamometer car, lent by the London and North-Eastern Railway Company, and a goods train of 220 tons. On the return journey, a heavier train was worked. The use of the new engine is expected to result in great savings in the light, local class of work. It can run either way equally well, and there is no necessity to turn it round. The driver has a look-out in all directions. A similar engine is now being built for the London and North-Eastern Railway Company. The one tested has a maximum speed of 25 miles an hour, but the makers are prepared to supply one capable of doing 40 miles an hour.

A New Reservoir.

The Corporation of Batley is greatly extending its waterworks by constructing a new reservoir in the Holme Valley, where it already has three. Preparatory work has been in progress since August last, and the blasting of the main trench was officially inaugurated last week. The reservoir is at Brownhill, Holmebridge, near Huddersfield. It was stated at the opening ceremony that its capacity would be 289 million gallons, or upwards of 60 million gallons more than the three present reservoirs at Ramsden, Yateholme, and Riding Wood. The trench will later on be filled with concrete to form the foundation of the embankment which will stretch across the valley. The total cost of the reservoir, with the pipe lines to Batley, will be about half a million sterling. The contractors are Messrs. Lehane, Mackenzie and Shand, of Darley Dale, Derbyshire. The François Cementation Company, of Doncaster, is carrying out grouting to make the reservoir water-tight, liquid cement being forced into the ground-work under pressure.

Sewerage and Electricity.

Last year the Spalding Urban District Council adopted a sewerage scheme to cost £72,000, but it was abandoned when it became known that no grant would be obtained from the Unemployemnt Grants Committee. Now, a modified scheme, to take in only part of the town, has been resolved upon. This scheme will cost some £42,000. The original design contemplated the use of compressed air mains, but the Council has decided that the engineering details shall be revised so as to embody, if possible, electric power, and an improvement in the purification system. At Darley Dale, a Ministry of Transport inquiry has been held with regard to the proposal of the Notts. and Derby Electric Power Company to supply electricity to the area. It is proposed that the cable shall be carried from Matlock, a distance of over 3 miles. Part of it will be laid underground, at an estimated cost of £7850, and part overhead, at a cost of £4950. It was stated that the two local Councils had joined in opposition, mainly because of the overhead route, but Mr. Phillips, manager of the company, who gave evidence, claimed that the overhead line would not be unsightly.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THERE is still an atmosphere of settled gloom in North of England trade circles. At this period of the year there is usually a spurt in most branches of industry, but the long hoped-for improvement has not yet materialised. A little more activity is to be noted in the shipbuilding and engineering trades, but the depression in the iron and steel industries is still acute, and the prospects do not give much hope of an early improvement. Producers declare that current rates are unremunerative, and a further fall in quotations threatens to be speedily followed by the closing down of more works. Some firms are already running their plant at a loss, delaying suspension of operations in the hope of an early turn for the better, but a continuation under present conditions cannot be expected to last much longer.

Cleveland Iron Trade.

It is difficult to discern a single bright feature in the Cleveland pig iron trade. The foreign business has almost vanished, and, indeed, the invasion of British markets by European producers has assumed very serious proportions. Nor is there the slightest improvement in home industrial conditions, such as might justify the hope of an expansion in the consumption of British pig iron. The consequence is that prices, which are already below the cost of production, continue to sag, and, indeed, it is only possible to give approximate quotations, the position being that makers are willing to bargain with industrial buyers according to the size of the order—the bigger the order the lower the price. As a general market rate No. 3 G.M.B. Cleveland pig iron may be quoted at 75s. per ton, with No. 1 at 80s., No. 4 foundry 74s., and No. 4 forge 73s.

Hematite Pig Iron.

In the East Coast hematite pig iron trade, the position shows a slight improvement, as compared with that of a week ago. A few small sales are reported to European consumers, and this fact, coupled with a restricted output, has served to steady the price, mixed numbers being still quoted at 80s. 6d. and No. 1 at 81s. per ton. Still, better bargains might be struck by firms requiring iron in bulk.

Ironmaking Materials.

The foreign ore trade is in a lifeless condition. Consumers show no interest whatever in the market position, and sales are rarely heard of. Best Rubio ore is nominal at 22s. per ton c.i.f. Tees. Some of the Durham coke makers continue to name 22s. 6d. per ton as a nominal delivered price for good furnace coke, but 22s. is probably the maximum price obtainable.

Manufactured Iron and Steel.

The manufactured iron and steel trade presents few new features. Costs of production are on the down grade, and prices are inclined to ease under the stress of keen competition. Orders generally are for small quantities, and the best that can be said is that the position is no worse. Still, many of the works are operating from hand to mouth, and only galvanised sheet makers are really busy.

The Coal Trade.

The position in the Northern coal trade still gives cause for considerable anxiety. The prospects denote a very quiet time ahead, and although next month is a short working one, supplies are abundant, and with no competition from buyers, the undertone of the market is very disappointing. Fitters in most cases are making a

stand against further concessions, and buyers have either to pay recent values or the pits are laid idle. Coalowners complain that prices have reached a point at which most of the collieries, which are faced with gradually increasing losses, will be forced to submit to the inevitable. This week the business done has fallen a long way below expectations in view of the approaching holiday period. The Danish labour trouble has considerably reduced demands from that country, and there is no revival of demand from any other centre, while all home works' requirements are at a minimum. Thus supplies of every grade are offered beyond what the market can absorb. Orders for steam coals are still only forthcoming slowly, and actual dealings continue insufficient to make any impression on the easy tendency of values generally. Blyth and Tyne smalls, although under reduced output, are barely maintained at recent prices. The Durham gas coal trade is quiet, and, while owners quote last week's prices, prompt business in all grades can be effected at discounted values. The demand for bunkers is meagre, both for ships' use and for export to the coaling stations, with actual values depending on individual positions. Coke is in poor request, and, owing to lack of storage room, many makers are eager to clear considerable quantities, and indicate low values

SCOTLAND.

(From our own Correspondent.)

Continued Depression.

NOTHING occurred during the past week calculated to lighten the depression in commercial circles generally. On all sides complaints are heard of the scarcity of orders and the growing difficulty of securing fresh business, especially in steel, iron and coal. So far as foreign markets are concerned, home producers are apparently hopelessly outbid, or at least such has been the case for some time. Instances of home producers securing contracts in overseas markets have cropped up of late, and the hope is ever present that a general change for the better may be imminent, and many concerns are induced to hang on which otherwise would have closed down until the arrival of better times. Two or three instances of firms supporting home industries in the face of cheaper foreign tenders have been a source of satisfaction, and it is hoped that others in a position to do so may follow suit. It is difficult to see how trade can revive otherwise so long as foreigners are able to undercut to the same extent as at present. The state of local markets is such that no relief from the loss of overseas business may be expected, and the effect of this is most evident in the coal trade and to a lesser degree in iron and steel.

Steel.

So far as steel is concerned, buying is still more or less confined to small lots for immediate consumption. Since the "freeing" of prices competition seems keener than ever, as Scottish makers have to contend not only with foreigners but English firms as well. Consumers are evidently convinced that prices must go lower and cannot under any circumstances go higher. Sales of shipbuilding materials are particularly slow, and producers are greatly in need of fresh contracts for plates and sections. Black sheets are quiet and galvanised varieties alone seem able to hold their own. So far as steels are concerned, however, makers believe that consumers' stocks are now low, and that fresh orders cannot be long delayed.

Iron.

There has been nothing of particular interest in bar iron, but makers anticipate some orders in connection with contracts for wagons which have recently been placed in this district. The price for "Crown" quality bar iron stands at £11 12s. 6d. per ton home delivery, but something less than that can be done for a good order. Re-rolled steel is practically stagnant, despite the probability of easy terms.

Iron Trade Wages.

In view of the fact that the examination of the employers' books for March and April has revealed an average net selling price of £11 19s. 4.15d. per ton, the wages of employees will suffer a decrease of 2½ per cent.

Pig Iron.

The Scottish pig iron trade remains where it was, in a state of inactivity. Small lots constitute the buying for home delivery, while export shows no sign of development. The general tone of the market inclines to further weakness.

Coal.

The situation in the coal trades still gives cause for considerable anxiety. Export orders have been dwindling for months back, and the collieries in Fifeshire and the Lothians are particularly hard hit. Prices have been reduced until there is hardly a bare margin over costs, and still quotations appear unfavourable in competition with foreign terms. In connection with the Swedish State Railways' contracts, the collieries interested have intimated to exporters their willingness to do business to the extent of 120,000 tons of Cowdenbeath and 40,000 tons Lochgelly at 15s. 9d. per ton f.o.b. Home demands for fuel are also most unsatisfactory owing to the industrial depression and the diminished requirements for general utility concerns and household purposes. In order to preserve a measure of employment, some collieries have offered to continue on a lower wages basis, but so far without coming to terms with employees, who in most cases are unwilling or unable to accept in view of the terms of the national agreement. Additions have been made to the number of idle pits, and at practically all those now in operation short time is the order of the day.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE conditions in the steam coal trade this week have been rather featureless, and, if anything, are not quite as satisfactory as they have been of late. The demand has become somewhat quieter, and shipments are not so active. This is apparent from the fact that the number of idle loading appliances at the various docks is slightly larger. There is a general feeling of quietness prevailing. Yet business is as difficult as ever, and, while orders are scarcer, tonnage is not so freely obtainable. The position is that shipowners are experiencing more difficulty in running their steamers at the rates of freight obtainable, and tonnage is being temporarily laid up. It is a very significant feature of the return, that by far the bulk of the steamers which are being taken up for the shipment of coal cargoes from this district are foreign owned, which shows that foreigners can run their tonnage more cheaply than British owners, if they are able to make their vessels pay on the rates ruling. As far as coal values are concerned, there is no doubt that the market has developed slightly more irregularity, and there is not the pressure in loading that was expected on the eve of the holidays. Most buyers have now made their arrangements for supplies for shipment before and immediately after the vacation, which accounts to some extent for the falling off in activity. Interest in the labour situation has lessened to some extent, in view of the decision of the Blackpool conference of the Miners' Federation. It was thought that some vital result would have been reached as affording some guide as to what is likely to happen regarding the new wages agreement. It is, of course, looked upon as satisfactory in a way that the Executive Committee is authorised to continue investigations, in conjunction with the coalowners, into the conditions of the industry, but at the same time the feeling of uncertainty is prolonged.

Coalfield Items.

Meantime miners in various parts of the coalfield are receiving notices to terminate their employment on account of the depression. At the end of last week it was officially announced that notices were to be served upon over 2000 men engaged at the Mardy pits of the Lockets Merthyr Company. In this case the management posted up at the collieries posters acquainting the men of the main causes for the action by the directors, and it was pointed out that, by comparing Mardy figures with the average figures for the South Wales steam coal collieries, it was found that the output per collier was 3 cwt. per shift lower; the output per person employed was 1.15 cwt. per shift lower; and that the average wages paid per person employed at the coal face was 1s. per day higher. The workmen were practically invited to co-operate with the company in reducing the cost of production, and thus enable it to meet the competition prevailing, otherwise there was no alternative but to close the pits. In the Garw district there are now about 4000 men unemployed, and in the Bridgend district about 1600 miners are affected by notices which have been served to the men at various pits. In the case of the Bedwas Navigation Colliery, where employers and men have been co-operating in order to prevent the pits from being closed, the experimental period has come to an end, but it has been agreed to continue the working of the scheme for three months. Under the new arrangement it has been agreed that a tonnage rate of 1s. 1d. per ton on every ton produced over 11,000 tons per week shall be paid, and with that incentive during the experimental period output was increased from 11,300 to 12,200 tons per week. Both the owners and the workmen are pleased with the result. Reference has been made to the decision of the workmen at the Blaenavon collieries to reject the proposals submitted to them for a resumption of work. The scheme, the main point of which was that the miners should turn out a larger percentage of large coal, was agreed to by the management and the men's leaders.

Dry Dock Deal Negotiations Off.

It is now officially stated that the negotiations for the amalgamation of the Cardiff Channel Combine with Messrs. Elliot and Jeffery have terminated, and, consequently, the acquisition of the property of the latter firm will not take place. As stated last week, in the event of the amalgamation taking place, it was understood that Mr. John Elliot, partner in the firm of Messrs. Elliot and Jeffery, would become the managing director of the whole Combine.

Tin-plate Joint Council.

The annual meeting of the Tin-plate Joint Council has now been fixed for June 5th. The unions that will be represented have on the agenda for submission items which include the question of the policy of the trade towards stabilisation and the necessity for re-establishment of the Stabilisation Committee; to decide the relationship of the workmen's representatives to such a committee and its policy; the pooling system and its effect on employment and production, &c.

Holidays at Mine and Docks.

The Coal Conciliation Board has arranged that the workers in the coalfield are to have the first three days of next week as holidays, while so far as the docks are concerned, the tippers and trimmers will have Monday and Tuesday as holidays and on Wednesday two short shifts will be worked, viz., from 8 a.m. to noon and from noon to 4 p.m. Work will be resumed as usual from 6 a.m. on Thursday morning.

Current Business.

Actual business has been very quiet during the past week. Prices have been fairly well maintained in the case of the superior qualities, but otherwise values have displayed more irregularity. Inferior qualities are relatively in greater need of prompt orders. Small coals have become rather more plentiful, and are easier, and the lower grades of patent fuel are slightly weaker. Anthracite coals are as firm as ever, though duff coals are still on the weak side and offered freely.

LAUNCHES AND TRIAL TRIPS.

INVERROSA, oil vessel; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co., Ltd., for the Lago Shipping Company, Ltd.; dimensions, 315ft. by 50ft. broad; 2360 gross tonnage. Engines, twin-screw triple-expansion, pressure 180 lb.; constructed by the builders; delivered, April 24th.

BARDIC, steamer; overhauled by Harland and Wolff, Ltd., to the order of the White Star Line; dimensions, 450ft. by 58ft. by 40ft.; 8000 gross tonnage. Engines, twin-screw triple expansion, pressure 200 lb.; delivered, April 25th.

ROEBUCK, twin-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Great Western Railway Company, Ltd.; dimensions, 210ft. by 33ft. 6in. beam; to carry 600 tons deadweight. Engines, twin-screw triple-expansion; constructed by the builders; trial trip, April 25th.

ROI ALBERT, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of L. Dens and Co.; dimensions, 315ft. by 45ft. by 22ft. 10in.; 4660 tons. Engines, inverted, direct-acting, triple-expansion; constructed by Wallsend Slipway and Engineering Company, Ltd.; trial trip, April 29th.

SHELTON WEED, steamer; built by Earle's Shipbuilding and Engineering Company, Ltd.; to the order of the Eastern Steamship Company, Ltd.; dimensions, 258ft. by 44ft. by 20ft. Engines, triple-expansion, surface-condensing. 17in., 28in., 46in. by 33in. stroke, pressure 180 lb.; constructed by the builders; trial trip, April 29th.

BRITISH CHEMIST, oil tank vessel; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the British Tanker Company, Ltd.; 10,000 tons deadweight. Engines, single screw oil to develop 3000 brake horse-power; constructed by the builders; launch, May 7th.

DALMARNOCK, twin-screw sludge steamer; built by Wm. Simons and Co., Ltd., to the order of the Corporation of Glasgow, Sewage Department; dimensions, 260ft. by 42ft. by 16ft.; 1400 tons. Engines, triple-expansion, surface condensing, pressure 180 lb.; constructed by the builders; launch, May 8th.

REDRIFF, collier; built by the Tyne Iron Shipbuilding Company, Ltd., to the order of the South Metropolitan Gas Company; dimensions, 244ft. by 36ft. 6in. by 20ft. 6in.; 2435 tons deadweight. Engines, triple-expansion screw, 18in., 30in., and 49in. by 33in. stroke, pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company, Ltd.; launch, May 9th.

DUC DE BRABANT, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of L. Dens and Co.; dimensions, 315ft. by 45ft. by 22ft. 10in.; 4660 tons. Engines, inverted, direct-acting, triple-expansion; constructed by the Wallsend Slipway and Engineering Company, Ltd.; launch, May 11th.

INANDA, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Charente Steam Company; dimensions, 406ft. 6in. by 52ft. by 31ft.; 6925 tons. Engines, quadruple-expansion, inverted reciprocating; constructed by the Wallsend Slipway and Engineering Company; trial trip, May 11th.

MARUJA, twin-screw tanker; built by the Rotterdamsche Droogdok Maatschappy, to the order of the Curacaosche Scheepvaart, Maatschappy; dimensions, 305ft. by 50ft. beam; 2698 gross tonnage. Engines, two triple-expansion; constructed by the builders; trial trip, May 12th.

SAMBUR, steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Great Western Railway Company; dimensions, 210ft. by 33ft. 6in. beam; 600 tons deadweight. Engines, twin-screw, triple-expansion, steam; constructed by the builders; trial trip, May 13th.

BELVOIR, steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the International Waterways Navigation Company, Ltd.; dimensions, 248ft. by 43ft. 6in. by 25ft. Engines will drive a single propeller; constructed by MacColl and Pollock; launch, May 19th.

PLATON, steamer; built by W. Gray and Co., Ltd., to the order of the Compagnie de Navigation d'Orbigny, of Paris; dimensions, 412ft. 6in. by 53ft. by 27ft. 6in.; 4610 gross tonnage; deadweight about 8100 tons. Engines, triple-expansion, 26in., 43in., 71in. diameter by 48in. stroke, pressure 180 lb.; constructed by the builders.

KONINGIN ELISABETH, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of L. Dens and Co.; dimensions, 315ft. by 45ft. by 22ft. 10in.; to carry about 4660 tons. Engines, inverted, direct-acting, triple-expansion; constructed by the Wallsend Slipway and Engineering Company, Ltd.; trial trip, May 22nd.

CATALOGUES REQUIRED IN PALESTINE.—The Department of Overseas Trade is informed by the Government of Palestine Department of Customs, Excise and Trade that the Chief British Representative, Trans-Jordan Government, Amman, is desirous of receiving British catalogues, lists, pamphlets, &c., in connection with the following subjects:—(*a*) Construction of roads, (*b*) construction of buildings, (*c*) construction of bridges, (*d*) construction of water supply, and (*e*) irrigation and drainage, sanitation.

ENGINEERING GOLFING SOCIETY.—The spring meeting of the Engineering Golfing Society was held at Rye on Saturday and Sunday, 23rd and 24th inst. There were forty-one competitors, and the weather permitted the competitions to be carried through successfully on both days. On Saturday morning four-ball foursomes against bogey were played, the first prizes being won by D. T. Powell and H. P. Gaze 3 up; the second prizes going to G. N. Watney and A. Valon 2 up. In the afternoon matches were played between teams representing the Institution of Civil Engineers and the Institutions of Mechanical and Electrical Engineers, the Mechanicals and Electricals winning 6 to 4. On Sunday morning 18-hole stroke competitions under handicap were played. In the First Division, for members with handicaps of 10 and under, the "President's Challenge Cup," presented by Sir Alexander Kennedy, was won by J. R. Dallmeyer with 92 – 10 = 82, after a tie with G. N. Watney. Second prize was taken by D. B. Mansergh with 86 – 6 = 80. In the Second Division, for members with handicaps of 11 and over, the "Wilson Challenge Cup," presented by Mr. R. P. Wilson, was won by S. Price-Williams with 93 – 12 = 81; the second prize going to H. G. Hale with 95 – 12 = 83. The prize for the best scratch score, presented by the Captain, Mr. J. R. Sharman, was won by G. N. Watney with 83. On both afternoons various friendly matches were played between the competitors.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	20/-
(1) Spanish	21/-
(1) N. African	21/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 10 0	—
No. 1 Foundry	4 8 0	—
No. 3 Foundry	4 6 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 0 6	4 0 6
No. 1	4 1 0	4 1 0
Cleveland—		
No. 1	4 0 0	4 0 0
Silicious Iron	4 0 0	4 0 0
No. 3 G.M.B.	3 15 0	3 15 0
No. 4 Foundry	3 14 0	3 14 0
No. 4 Forge	3 13 0	3 13 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 9 0 to 3 10 0	
,, Forge	3 6 0 to 3 7 0	
(3) Derbyshire—		
No. 3 Foundry	3 15 0	—
Forge	3 10 0 to 3 12 0	
(3) Lincolnshire—		
No. 3 Foundry	4 0 0	—
No. 4 Forge	3 15 0	—
Basic	3 15 0	—
(4) N.W. Coast— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 13 0 (a); 4 14 0 (b); 5 1 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 12 6	—
Best ,,	—	—
N.E. Coast—		
Common Bars	11 12 6	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 10 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 12 6 to 12 15 0	
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 12 6 to 11 15 0	
Gas Tube Strip	13 0 0	—

STEEL.

	(6) Home. £ s. d	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	12 0 0	—
Ship Plates, ½in. and up	8 17 6	—
Sections	8 7 6	—
Steel Sheets, under 3/16in. to ½in.	10 5 0 to 10 10 0	
Sheets (Gal. Cor. 24 B.G.)	—	17 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	—
Angles	8 7 6	—
Boiler Plates	13 0 0	—
Joists	8 7 6	—
Heavy Rails	8 15 0	—
Fish-plates	12 15 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 5 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 15 0†	—
Light ,,	9 0 0 to 9 5 0	
Billets	8 0 0 to 11 0 0†	
Manchester—		
Bars (Round)	9 0 0 to 10 0 0	
,, (others)	8 15 0 to 9 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	9 5 0	—
,, (Lancs. Boiler)	12 10 0	—
Sheffield—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0 to 8 5 0	
Hoops	12 0 0	—
Soft Wire Rods	9 10 0 to 11 0 0	
Midlands—		
Small Rolled Bars	8 15 0	—
Billets and Sheet-bars	6 17 6 to 7 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 10 0 to 16 15 0	
Angles	8 7 6 to 8 15 0	
Joists	8 7 6 to 8 15 0	
Tees	9 10 0 to 9 15 0	
Bridge and Tank Plates	9 5 0 to 9 10 0	
Boiler Plates	13 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	20/- to 20/6
Block Tin (cash)	252 10 0
,, (three months)	252 10 0
Copper (cash)	60 0 0
,, (three months)	61 0 0
Spanish Lead (cash)	32 15 ?
,, (three months)	32 13 9
Spelter (cash)	35 0 0
,, (three months)	33 17 6
Manchester—	
Copper, Best Selected Ingots	63 10 0
,, Electrolytic	64 10 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
,, Condenser	0 1 2
Lead, English	35 0 0
,, Foreign	33 15 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 to 1/9 per lb.	
Ferro Tungsten	1/5 to 1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 5 0	7/9
,, 8 p.c. to 10 p.c. ,,	£23 0 0	7/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£43 0 0	15/6
,, ,, 1 p.c. ,,	£52 0 0	17/-
,, ,, 0.70 p.c. carbon	£57 10 0	19/-
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 15 0 unit	scale 5/- per
,, ,, 75 p.c.	£22 10 0 unit	scale 8/- per
,, Vanadium	17/- per lb	
,, Molybdenum	7/- per lb.	
,, Titanium (carbon free)	1/- per lb	
Nickel (per ton)	£175	
Cobalt	10/3 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/9
,, ,, Ell	15/6
,, ,, Splint	16/- to 18/9
,, ,, Trebles	14/3
,, ,, Doubles	13/3
,, ,, Singles	12/6
Ayrshire—	
(f.o.b. Ports)—Steam	14/9
,, ,, Splints	16/-
,, ,, Trebles	14/3
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	13/7½ to 15/7½
Screened Navigation	21/6
Trebles	15/- to 15/9
Doubles	12/6
Singles	12/6
Lothians—	
(f.o.b. Leith)—Best Steam	15/6
Secondary Steam	15/-
Trebles	15/10½
Doubles	13/6
Singles	12/9

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	26/-
Household	45/- to 58/4
Coke	28/-
Northumberland—	
Best Steams	17/-
Second Steams	16/-
Steam Smalls	10/6 to 11/9
Unscreened	15/6 to 16/6
Household	23/6 to 25/-
Durham—	
Best Gas	19/-
Second	16/6 to 17/-
Household	23/6 to 25/-
Foundry Coke	20/9
Sheffield—	Inland.
Best Hand-picked Branch	30/- to 33/- —
Barnsley Best Silkstone	26/- to 27/- —
Derbyshire Best Brights	26/- to 28/6 —
,, ,, House	23/6 to 25/6 —
,, ,, Large Nuts	18/- to 22/- —
,, ,, Small	14/- to 16/- —
Yorkshire Hards	18/- to 22/- —
Derbyshire ,,	18/6 to 22/- —
Rough Slacks	10/- to 12/6 —
Nutty ,,	8/6 to 10/- —
Smalls	3/- to 5/6 —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 21/3 to 22/3

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	26/3 to 26/9
Second ,, ,,	25/3 to 26/-
Best Dry Large	25/- to 25/6
Ordinary Dry Large	23/6 to 24/6
Best Black Vein Large	24/6 to 25/-
Western Valley ,,	23/6 to 24/6
Best Eastern Valley Large	23/- to 24/-
Ordinary ,, ,,	22/6 to 23/-
Best Steam Smalls	15/6 to 16/-
Ordinary ,,	13/- to 15/-
Washed Nuts	20/- to 27/6
No. 3 Rhondda Large	26/9 to 27/3
,, ,, Smalls	17/- to 17/6
No. 2 ,, Large	22/- to 23/-
,, ,, Through	18/- to 20/-
,, ,, Smalls	12/- to 13/6
Foundry Coke (export)	40/- to 47/6
Furnace Coke (export)	25/- to 30/-
Patent Fuel	22/- to 26/-
Pitwood (ex ship)	24/- to 24/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	44/- to 46/-
Seconds	38/- to 40/-
Red Vein	30/- to 32/6
Machine-made Cobbles	52/6 to 55/-
Nuts	50/- to 55/-
Beans	37/6 to 40/-
Peas	21/6 to 23/6
Broaker Duff	8/- to 8/3
Rubbly Culm	12/- to 13/6
Steam Coals:	
Large	23/6 to 25/-
Seconds	21/- to 22/-
Smalls	10/- to 13/-
Cargo Through	16/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 16/6, with fluctuations according to analysis; open market, 18/- to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Naval Programme.

THE types of vessels to be put upon the stocks this year in accordance with the recent vote of the Chamber of Deputies are not meeting with general approval, principally because it is obvious that the 8000-ton cruisers Lamotte-Piquet, Duguay-Trouin and Primeauguet already find their military value practically neutralised by the 10,000-ton cruisers constructed in other countries. All the other French cruisers, which will reach the tonnage limit allowed by the Washington Convention, will equal in speed the 8000-ton cruisers, and will have the advantage of a far more powerful armament. It is asked why these light vessels should be built at all. They will have an overall length of 181 m., and the engines will develop 100,000 horse-power, which will give a speed of 34 knots. The armament will consist of eight 155 mm. and four 75 mm. guns and twelve torpedo tubes, whereas the 10,000-ton cruisers, both French and foreign, will have approximately the same speed and will carry at least eight 203 mm. guns as well as an armoured belt. Again, there is some criticism of the destroyers, three of which are to be put on the stocks this year. It is argued that the destroyer of 2400 tons is not serviceable for directing the strategical movements of a flotilla of torpedo boats, which can be done more effectively by a small cruiser that is not inferior in speed and is far superior in armament to the destroyer, and that, by eliminating the destroyer, it is proposed that the fleet could be reduced with advantage to three types of vessels :—The 10,000-ton cruiser, the 4000-ton cruiser, which would accompany the torpedo boats and protect them from destroyers, and the torpedo boats themselves, two of which could be built for the cost of one destroyer. On the whole, the French naval experts are not satisfied with the programme, which does not give the greatest efficiency for the money expended, and there is some regret that the country is not yet in a position to follow the lead of certain other Powers in bringing up the fleet to its full strength by the construction of battleships. In addition to one 8000-ton cruiser and three destroyers, the programme provides for the laying down this year of four torpedo boats, seven first-class submarines, two mine-laying submarines, one surface mine liner and one seaplane carrier. The leading idea of French naval strategy is to keep the route open between France and North Africa, which cannot be done with mines, and the lack of battleships and heavy artillery is regarded as a serious source of weakness.

Foreign Trade.

For some time past there have been general complaints of a lull in business, and, contrary to former experience, the further depreciation of the franc has not been accompanied by an increased buying on export account, despite the efforts being made by iron and steel firms to maintain prices on the home market with the idea of offering specially favourable terms to foreign buyers. The situation is becoming steadily worse, and the trade returns for the first four months of the year reveal, on the whole, an appreciable reduction in foreign exchanges. The imports during the first four months of the year were valued at 12,876 million francs, representing a decrease of 613 million francs, as compared with the similar period of last year. There was a small increase in the imports of manufactured goods, but a heavy decrease in the value of raw material imported, owing largely, no doubt, to the cessation of consignments of domestic fuels. The consumption of industrial coal is also manifestly much less. As regards quantities, the imports showed a reduction all round, the total for the four months being 15,098,602 tons, or 2,950,713 tons less than in the corresponding period of last year. This reduction was due almost entirely to coal and other raw material. The value of the exports is returned as 14,477 million francs, a decline of 512 million francs, which is due mainly to foodstuffs and manufactured goods. The quantities, however, were more satisfactory, for the total of 10,179,963 tons was 1,103,501 tons in excess of the amount for the first four months of last year. A curious feature is that while the exports of manufactured goods increased by 67,927 tons, the value declined by more than 167 million francs, and an increase of 1,081,000 tons in raw material exported was accompanied by a decline in value of 93 million francs.

The Grenoble Exhibition.

Being held in one of the main centres of hydro-electrical distribution, the Exhibition at Grenoble promises to be the most interesting manifestation of this branch of industry that has yet been held. Officially initiated last week, it appears to be in a more advanced state of completion than is usual for exhibitions, and it will certainly be both attractive and instructive, for one of the objects of the organising committee was to give a spectacular display of electricity and at the same time to insure the participation of electrical engineers from all the allied and neutral countries. The number of hydro-electric installations in the Grenoble district offers additional interest to those visiting the exhibition.

The Ecole Centrale.

This country is probably one of the least favoured in the provision of laboratories for educational and research work. The number is sufficient, but the equipment is often totally inadequate, and remarkable research work is accomplished with more or less rudimentary appliances. In the Ecole Centrale, which is second only to the Ecole Polytechnique, a really modern and well-equipped laboratory has recently been installed through the initiative of Professor Léon Guillet, who has succeeded in raising the necessary funds by subscription not only for the laboratory but also for the provision of accommodation for students, a number of whom can now live at the school very cheaply. At the opening ceremony Professor Guillet declared that one of his aims was to remove financial disabilities from the path of those who had real talent and who desired to be trained as engineers.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

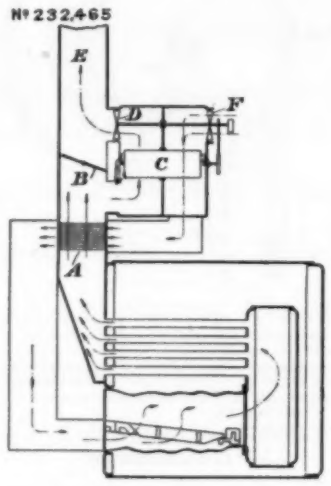
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application ; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

232,465. July 21st, 1924.—AIR PREHEATERS, *R. Haddan* 31 *and* 32, *Bedford-street, Strand, London, W.C.* 2.

This invention appears to be merely a combination of the Ljungström type of air preheater with a tube preheater, with the idea that the tubular part of the apparatus will insure the rotary part from damage through overheating. The flue gases

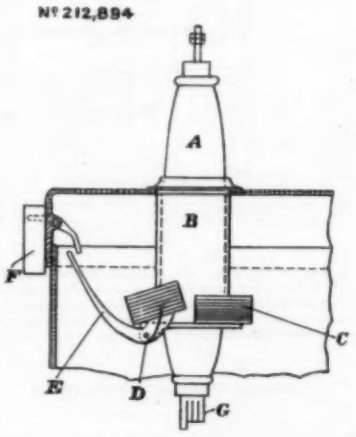


from the boiler first go through the nest of tubes A and are then diverted by the damper B to the rotary preheater C, through which they are drawn, on the left, by the fan D and discharged to the uptake E. The incoming air is drawn in by the fan F, goes down through the right-hand side of the rotary heater, through the tubes of the heater A, and then to the furnace.—*April* 23*rd*, 1925.

SWITCHGEAR.

212,894. February 29th, 1924.—OVERLOAD RELAY FOR ELECTRIC OIL SWITCHES CARRYING LARGE CURRENTS, Voight and Haeffner Aktiengesellschaft, of Hanauer-Landstrasse, 146–158, Frankfurt-on-Main, Germany.

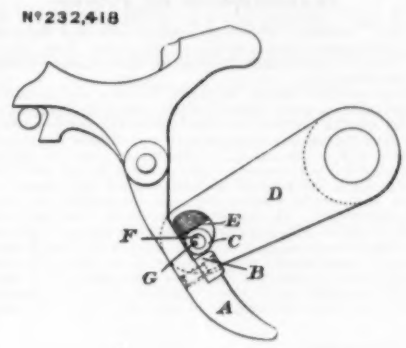
In high-voltage switches in which the release is effected by the direct response of high-tension magnets, it is necessary to connect the armature of the overload relay, which generally carries a high-tension current, with the releasing member by means of an insulating rod, affording adequate insulation. During operation this arrangement often leads to disturbances, because the



insulating material that is employed either has a great tendency to act hygroscopically or it does not always stand the impacts that are produced when a short circuit takes place. According to this invention the conduit A is provided with an earthed metal sleeve B, around which is mounted the yoke C of the magnet. The operating rod E which co-operates with the releasing parts F is actuated by the magnetic effect of the current flowing through the conductor or bolt that passes through the conduit A and which goes to the fixed contact G of the switch.—*April* 16*th*, 1925.

232,418. May 1st, 1924.—IMPROVEMENTS RELATING TO TRIP OR RELEASE MECHANISMS FOR ELECTRIC CIRCUIT BREAKERS AND LIKE APPARATUS, George Ellison and Thomas Brown, both of Wellhead-lane Works, Perry Bar, Birmingham.

The object of this invention is to provide an improved anti-friction device between the inter-engaging elements of trip or release mechanisms for electric circuit breakers and similar apparatus. The object is to reduce friotional resistance and to effect the desired result in the simplest possible manner. The lever A, which is actuated by the release mechanism, has a shoulder B for co-operating with one side of a roller C. On the other lever D, connected to the switch mechanism, there is a flat surface E, which makes contact with the other side of the roller. The roller is formed with a large central aperture F, in which there is a pin G, secured to the second lever D, that serves mainly to connect the roller to the lever. The pin also serves to limit the extent to which the roller can move. The position of the pin is such that when the levers are engaged, the centre of the roller coincides with the line of pressure between

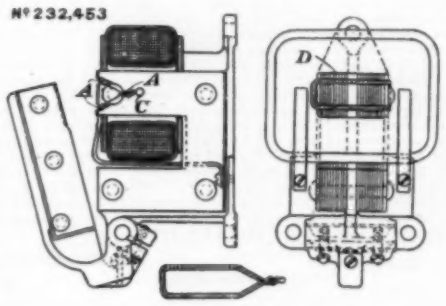


the interacting parts of the levers, the line passing through the pivot centre of the lever A, which is actuated by the releasing mechanism. When the latter lever moves relatively to the other, the roller also moves on account of the freedom of its axes, and in consequence the frictional resistance to be overcome is very small.—*April* 23*rd*, 1925.

ELECTRICAL APPLIANCES.

232,453. June 30th, 1924.—IMPROVEMENTS IN AND RELATING TO ALTERNATING-CURRENT ELECTRO-MAGNETS, *The Igranic Electric Company, Limited*, 147, *Queen Victoria-street, E.C.* 4.

Alternating-current electro-magnets are usually provided with a shading coil to prevent humming or chattering of the magnet armature, and it is common practice to employ a shading coil consisting of a single piece of wire formed to provide a loop, and having its ends secured together by welding. Such shading coils often break, especially at or adjacent to the weld, after a relatively small number of operations of the magnet, and it has

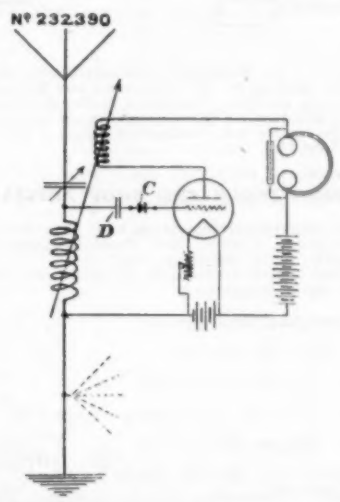


been found that such breakage is largely due to the fact that the coil is relatively rigid and incapable of withstanding shocks caused by impact of the armature member against the field member. One of the objects of this invention is to provide an improved shading coil which will overcome this objection. Recesses A receive the shading coil which consists of a piece of stranded wire formed to provide a loop and having its ends twisted together, connected at C by welding or soldering. The shading coil is held in the recesses by binding portions of the laminations of the core D over the coil.—*April* 23*rd*, 1925.

TELEGRAPHS AND TELEPHONES.

232,390. March 14th, 1924.—IMPROVED METHOD AND MEANS OF RECTIFYING ELECTRIC OSCILLATIONS, APPLICABLE TO RADIO TELEGRAPHY, RADIO TELEPHONY AND THE LIKE, Alexander William Sharman, of 1, Morella-road, Wandsworth Common, S.W.

According to this invention, the grid of a thermionic valve is connected to the aerial tuning inductance through a crystal



C, and a small condenser D. It is said that the valve operates best as a detector with a voltage lower than that necessary for leaky grid detection. Owing to the existence of the blocking condenser, the grid normally becomes negative, as regards the filament, and the plate current is diminished to a small value. High-frequency impulses, transmitted through the condenser, cause the crystal detector to set up potential differences, which tend to render the grid less negative and the plate current con-

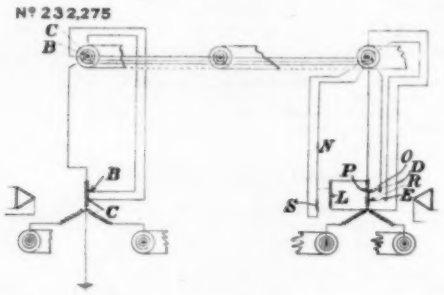
sequently increases. The modulated component of the plate current caused by rectification in this manner is said to be greater than that obtained by known rectification methods.—*April 23rd*, 1925.

TRANSMISSION OF POWER.

232,275. October 17th, 1923.—MEANS FOR AND METHODS OF SUPPLYING THE CHARGING CURRENTS FOR ELECTRIC CABLES, Alfred Mills Taylor, of Slade Lodge, Erdington, Birmingham.

This invention relates to Major Taylor's well-known intersheath cable system. The left-hand side of the diagram relates to the sending end and the right-hand side the receiving end. The extreme end of each secondary transformer winding at the sending end is connected to the centre core of the cable. Tappings B C are connected to the cores B C of the cable, as shown, but in the diagram this connection is only shown for one phase, although in practice the same connections are made on the other phases. The connections at the receiving end need not be described in detail, as they are more or less self-explanatory. The secondary winding P is connected to a winding L of a line-charging transformer, the secondary S of which is connected to the outer lead sheath of the upper cable and to the outer intersheath, whereby the requisite capacity current is transmitted to the outer slice of dielectric of the cable and an inductance is

Nº 232,275



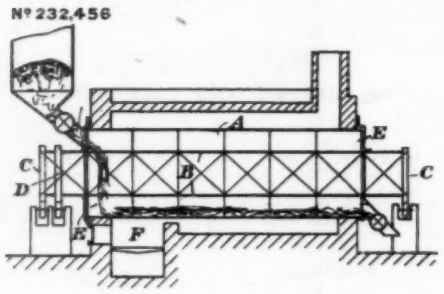
also connected at the point N. The requisite currents for the outer intersheaths of the cable may be taken from tappings O R. The switches D E admit of the transmission being carried on in the event of a breakdown in the transformer L S. It will be understood that the other phases are similarly dealt with. The transformer L S only deals with the charging current, whilst the main transformer supplies the load current. The arrangement ensures that a leading current is drawn into the primary winding L, and is fed from the secondary winding of the charging transformer to the outer intersheath, and all the charging energy is transmitted through the centre core of the cable at the highest voltage of transmission, and consequently with the lowest current, it being fed to the outer intersheath through the secondary winding S at a lower voltage, but at increased current. Moreover, the charging currents may be taken from the requisite tappings on the transformer without interfering with the current passing through the primary windings P, and the potential gradient between the respective intersheaths can be definitely proportioned. Various other advantages of the scheme are dealt with.—*April* 17th, 1925.

FURNACES.

232,456. July 11th, 1924.—ROTARY KILNS, *E. C. R. Marks, 57 and 58, Lincoln's Inn-fields, London, W.C. 2.*

This invention aims at overcoming the mechanical difficulties in the design of a rotary kiln for use in the distillation of coal and similar materials. For this reason the drum A of the kiln is mounted on an inner supporting member B, which is provided with the bearing roller rings C C and the driving ring D. The

Nº 232,456



end covers E E are comparatively light and flexible and are provided with openings for the introduction and discharge of the material to be distilled. The heating furnace is indicated at F. It will be seen that the bearing rings are not subjected to the heat of the furnace and consequently remain in good working order.—*April 23rd*, 1925.

MACHINE TOOLS AND SHOP APPLIANCES.

232,446. June 14th, 1924.—SLIDE REST FEED GEAR, W. B. Lang and L. Watkins, Mary-street, Johnstone, Renfrewshire.

This mechanism is for changing the feed of the saddle on a

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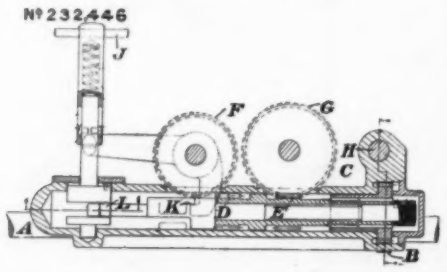
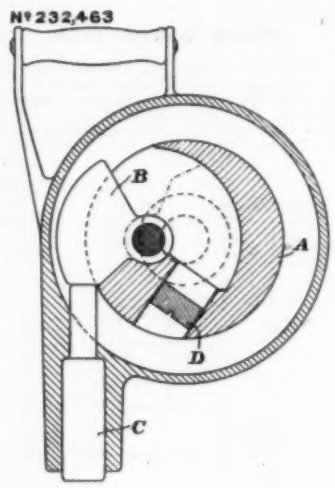


lathe or similar machine. The power for the feed is provided by the shaft A and is transmitted through gearing B to the sliding sleeve C. This sleeve has two worms D and E, which may be made to mesh with either of the two worm wheels F and G. It will be noticed that only one of the worm gears can be in mesh at one time. In order to effect a change of gear the whole assembly carrying the worms is swung about the pivot H by pressing on the handle J, which action incidentally releases the catch K. The handle J is then turned, so that the crank L pulls or pushes the required worm into position to mesh with its wheel, and the worm is lifted into the working position again.—*April 23rd*, 1925.

232,463. July 18th, 1924.—PERCUSSIVE TOOLS, A/S Fjeldbor and L. Rasch, Stortingsgate 14, Christiania, Norway.

This tool is a percussive hammer of the rotary type and comprises a rotating member A to which there is pivoted an excentric weight B. Under the influence of centrifugal force this weight

Nº 232,463



flies out and strikes the working bit C. The weight rebounds into a pocket in the member A, in which it is a comparatively good fit, so that an air cushion is provided to bring it to rest. The extent of the cushioning effect can be regulated by means of the screwed plug D, which alters the capacity of the recess or pocket.—*April 23rd*, 1925.

LOCOMOTIVES.

232,447. June 16th, 1924.—BOOSTER ENGINES, H. N. Gresley, Camlet House, Hadley Wood, Middlesex.

This invention is concerned with booster engines fitted to the radial axles of locomotives and aims at providing a substantial means for transmitting the thrust produced by the booster to the main frame of the locomotive. In the illustration the radial

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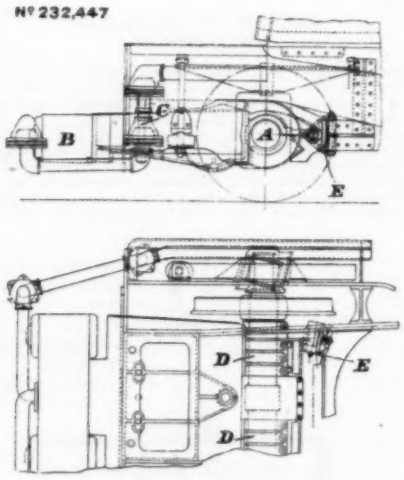

axle is shown at A, while the weight of the booster engine, marked B, is carried by the link C and the bearings D D. The propulsive thrust produced by the engine is transmitted to the main frame through the sliding blocks E, which are articulated to accommodate movements of the axles.—*April 23rd*, 1925.

NON-FERROUS STANDARD SAMPLES.—We are informed that the British Chemical Standards have issued the first of a series of non-ferrous standard analysed samples having the following analysis:—White metal "A" (lead base): Lead, 82.58 per cent.; antimony, 12.05 per cent.; tin, 4.64 per cent.; copper, 0.34 per cent.; iron, 0.07 per cent.; bismuth, 0.03 per cent.; arsenic, 0.06 per cent.; zinc, 0.08 per cent.; total, 99.85 per cent. The standard has been prepared (by a novel method to ensure homogeneity) to meet the need of chemists who wish to check the methods they use for the analysis of lead-base alloys, such as bearing metal, terne metal, stereotype metal, magnolia metal, hard (antimonial) lead, tea lead, plumbers' solder, stuffing-box alloys (metallic packing), "lead wool," &c. The difficulties encountered during standardisation emphasised the need for and value of such a standard. As usual, the analyses have been undertaken by a number of chemists having special experience in this class of alloy, *e.g.*, referee analysts, manufacturers, users, and Government Departments, including the Research Department, Woolwich, and the Bureau of Standards, U.S.A. The standard is available to anyone at a price based on the cost of preparing and issuing it. The three usual sizes of 50 g., 100 g., and 500 g. are provided, and a certificate (first edition) giving the names of the analysts collaborating and their analyses is furnished with each sample. In a later edition an outline of the methods employed will be included and sent on request in exchange for the first edition. Further particulars can be obtained from British Chemical Standards, 3, Wilson-street, Middlesbrough.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHEMICAL ENGINEERING GROUP.—Chemical Industry Club, 2, Whitehall-court, London, S.W. 1. Sixth annual general meeting. 8.15 p.m. To be preceded by an informal dinner at 7 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Scenery in the Pastoral Poets," by Sir Henry Newbolt. 9 p.m.

WEDNESDAY, JUNE 3RD.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "The Effect of Wave Damping in Radio Direction Finding," by Dr. R. L. Smith-Rose. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. "Passage of Electricity through Vacuum Tubes, III.," by Professor R. Whiddington. 5.15 p.m.

THURSDAY TO SATURDAY, JUNE 4TH TO 6TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Meeting in Scottish District at Dumfries.

FRIDAY, JUNE 5TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "The Tomb of Tut-ankh-amen," by Mr. Howard Carter. 9 p.m.

SATURDAY, JUNE 6TH.

INSTITUTION OF ENGINEERS-IN-CHARGE.—Visit to Bushey House, Teddington. 2.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting at Reading. 11 a.m.

MONDAY, JUNE 8TH.

FARADAY SOCIETY.—Institution of Civil Engineers, Great George-street, London, S.W. 1. Joint meeting with the Iron and Steel Institute. Symposium and discussion on "The Physical Chemistry of Steel Making Processes." 3.30 p.m.

TUESDAY TO FRIDAY, JUNE 9TH TO 12TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Summer meeting at Birmingham and District. For programme, see page 380.

INSTITUTION OF GAS ENGINEERS.—Annual general meeting in London. For programme, see page 414.

TUESDAY TO THURSDAY, JUNE 16TH TO 18TH.

INSTITUTION OF MINING ENGINEERS.—Eighty-third general meeting at Cardiff. For programme see page 608.

THURSDAY TO SATURDAY, JUNE 18TH TO 20TH.

NEWCOMEN SOCIETY.—Summer meeting at Gloucester.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. E. L. SAMSON informs us that he has resigned from the position of general manager of Ronald Trist and Co., Ltd., 12, Clipston-street, W. 1.

MR. E. W. DICKINSON, M.I.E.E., late Superintendent Engineer at the L.C.C. Power Station at East Greenwich, asks us to state that he has changed his address to 20, Essex-street, Strand, W.C. 2, and that his new telephone number is City 7014.

THE ELECTRICITY COMMISSIONERS announce that they are removing from Gwydyr House, Whitehall, S.W. 1, and that after June 1st next the offices of the Electricity Commission will be at Savoy-court, Strand, London, W.C. 2. Telephone No., Gerrard 7565.

WE are informed that the ss. A. P. Bernstorff, which is owned by the Det Forenede Dampskibs-Selskab (The United Steamship Company, Ltd.), Denmark, has now resumed service on the Esbjerg-Harwich run, after an extensive overhaul, including the replacement of her original boilers by four "Howden" marine type water-tube boilers working under "Howden" system of hot air forced draught. The boilers were manufactured under licence from James Howden and Co., Ltd., Glasgow, by the Frederikshavns Vaerft and Flydedok A/S., Denmark, which was also responsible for the overhaul and alterations to the ship.

CONTRACTS.

THE contract for the valves and ironwork for the Broomhead Reservoir valve shaft (Ewden Valley Waterworks) of the Sheffield Corporation has been let to Guest and Chrimes, Ltd., of Rotherham.

JOHN THOMPSON WATER TUBE BOILERS, Ltd., of Wolverhampton, has received a contract from the York Corporation for two of its patented vertical water-tube boilers, each to evaporate 25,000 lb. of steam per hour. The contract also includes superheaters, chain-grate stokers, economisers, brickwork setting, induced draught fan, and steel chimney.

HOWDEN-LJUNGSTROM PREHEATERS (LAND), Ltd., have received an order to supply one preheater to Brown and Adam, Ltd., dyers and bleachers, Riverbank Works, Pollokshaws, Glasgow. The total heating surface of the preheater is to be 26,000 square feet; air will be supplied to the furnace at about 385 deg. Fah.

SIR WILLIAM ARROL AND CO., Ltd., Glasgow, have received an order from the L.M. and S. Railway for large additions in connection with the reorganisation of the locomotive works at Crewe. The order comprises the steel buildings erected complete and also includes the overhead electric travellers, among which are six of 50 tons power, six of 10 tons power, and others of 8, 6, and 5 tons power.